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November 13, 1924

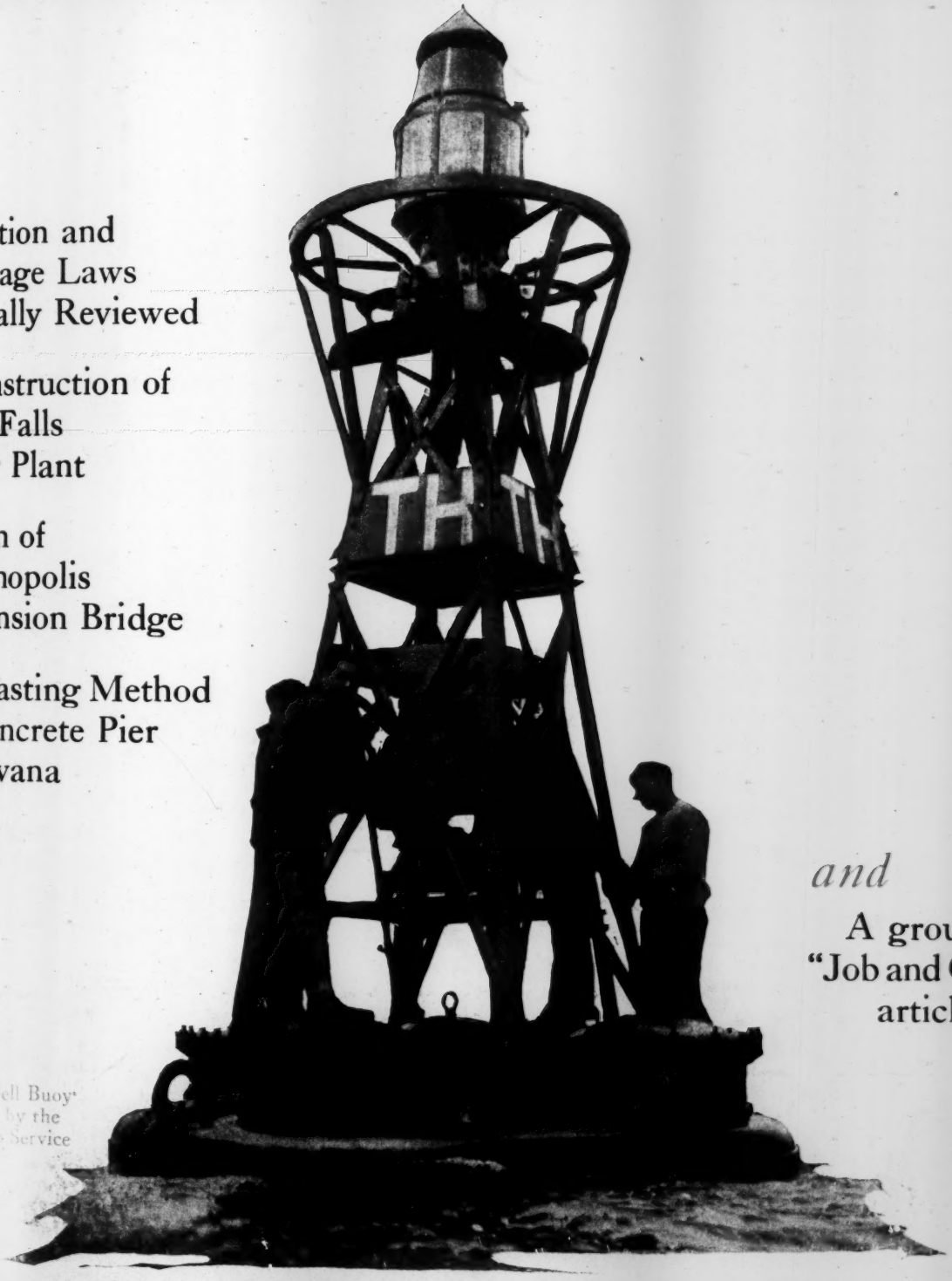
Engineering News-Record

Irrigation and Drainage Laws Critically Reviewed

Reconstruction of Speir Falls Power Plant

Design of Florianopolis Suspension Bridge

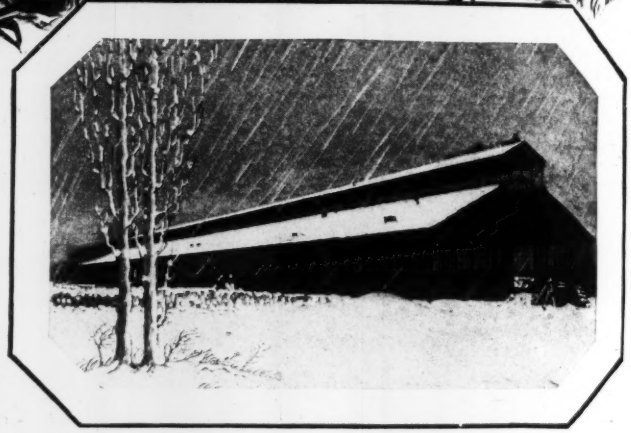
Pile Casting Method for Concrete Pier at Havana



Gas and Bell Buoy Developed by the Lighthouse Service

and

A group of "Job and Office" articles



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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 93 NEW YORK, NOVEMBER 13, 1924 Number 20

Good Business Ahead

CONFIDENCE is the major factor in government stability. History has shown that the radical come to power by anything short of revolution actually puts into effect few of his destructive ideas; the danger of the elected radical lies in the destruction of confidence, in the fear that causes business to contract and capital to hide, and all the fundamental economic soundness in the world will not avert bad times when this fear begins to operate. The election has saved the country from the loss of confidence that several of its contingent possibilities might have brought. This is a cheering prospect for the engineer, for it means that construction should continue to be a desired and necessary thing. Industry can count on a continuance of that prosperity the sound state of the country predicates, and a prosperous industrial condition means a proper amount of preparation for the future which in its turn means new construction. The railroads should be let alone for a sufficient time to show whether or not the Esch-Commins law is really going to work; economy in national government and sane administration of the national finances should result in reduced taxes, and government interest in business should be helpful not coercive or destructive.

State-Owned Power Rebuked

ONE of the important results of the election was the scotching of the government ownership snake. To Mr. La Follette government ownership of utilities has always been a major desideratum but curiously enough the exigencies of the campaign led the Democratic party into the strange woods of government ownership of water power. The Republicans took up the gauntlet and through their most powerful mouthpieces defended private initiative, and there is no doubt that their retention in power means an effective fight against such economic fallacies. In several of the Western states, too, specific efforts to provide state ownership of power failed, indicating a trend which is hopeful. It shows that the people are not to be deceived by the arguments that see in the opposition to state owned water power only the vicious and immoral influence of the money power. Impassioned pleas to save the country's national resource, flowing water, from the clutch of the "interests" must go down before the cold presentation of the facts as to state-owned power, the complication of development and distribution that such ownership involves and a fair statement of how privately owned power, publicly controlled, operates to the ultimate benefit of all the people.

Bond Issues Local Matter

THERE seems to be no decided trend in the bond or tax matters that came up for decision in the election. As the table in the news section this week shows the issues must have been largely local and there are about as many proposed public works—to be paid for by bonds or taxes—approved as were defeated. Kentucky refused a $75,000,000 road bond issue and its neighbor Illinois approved one for $100,000,000. This is an exhibition of state temperament; the one state has not as yet been sold on the necessity for more roads and inherently dislikes debt; the other has been in the forefront of road builders and the debt does not worry its citizens. So the other votes may be explained. There were those before the election who believe that the rising tax burden everywhere would serve to deter voters from any further expenditures but so far the returns indicate no such general tendency. It may be noted, however, that most of the proposals voted on were for bonds, which posterity must eventually pay, and the average man who thinks in terms of his immediate pocketbook is apt to consider such bonds of less burden on himself than the more tangible tax to be levied immediately.

Another Wreck

ONCE more the voters of an American city have wrecked a political machine. This smash-up was effected at Cincinnati on Nov. 4 when by a two-to-one vote the people followed the recent example of the voters of Cleveland and adopted the council-manager plan with the council so elected as to give proportional representation. The change at Cincinnati will also eliminate the partisan ballot. To retain this ballot and as much as might be hoped for in the way of district representation, and to avoid having a city manager, the dominant city and county political machine conceded a reduction in the council from 32 to 9 members and election at large of councilmen to serve districts, by filing a counter petition for a vote on that plan. Unknown or unnamed persons went the visible machine one better and presented a plan like that just outlined except that it retained election as well as representation by districts. Besides adopting the council-manager plan the voters continued their slaughter of proposed financial schemes that has been going on for a year or more, voting down for a second time authorization to go beyond the statutory tax limit, although this puts the city in a financial plight sadder than ever, and again picking and choosing between bond issues proposed by the city administration and endorsed by the city and county political organization.

Prophets Dishonored

CINCINNATI'S adoption of the manager plan is another blow to the prophets who declared that the plan would never be adopted by large cities, however many small ones might take it up. The facts belied the prophets from the start, unless "large cities" is made to mean "largest cities," for ten years ago the manager plan was given impetus when it was adopted by Dayton. The prophecy was shattered when Cleveland, with al-

most 800,000 population by the 1920 census, adopted the plan in 1921, effective Jan. 1, 1924. Today five American cities, all with considerably more than 100,000 population, have the plan in operation, and Cincinnati will put a manager in office a little over a year hence. If a city in the million-population class adopts and makes an apparent success of the city-manager plan is there any reason why still larger cities could not do so? Or is a million the dead line? A council of more than nine members might be considered desirable for cities larger, say, than Cincinnati. The council at Cleveland has 25 members, but Cleveland has double the population of Cincinnati in 1920. Worthy of consideration is the fact that the two largest manager cities choose their councils by proportional representation—a plan which seems far more truly representative than choice by districts where election-at-large is felt to be unrepresentative.

Power House Reconstruction

ADVANCES in turbine design and the great increase in interconnection of electric power systems in the last few years have made it expedient to reconstruct or replace the hydro-electric units in many of the older power houses on rivers of this country. In some cases such changes can be made simply, but more frequently the new units are much larger than the old ones and call for some ingenious plan of adapting the existing facilities to the new requirement. The first step in the reconstruction of the Spier Falls plant on the Hudson River, as described in this issue, is a case of this kind. It should be of interest to engineers who have a similar problem to deal with. Moreover, as the reconstruction was carried on in winter under adverse conditions other engineers may find the experience of the engineers who did the work enlightening. The very fact that the magnitude of the job did not warrant the use of elaborate equipment makes the results of value because so many engineers and contracts find themselves faced with the same necessity of working with more or less makeshift equipment.

Ethical Aspects of Underestimating

WORKING along a line of thought parallel to that presented in these columns last week under the heading "Why Do Engineers Underestimate?", a committee of the American Association of Engineers has been at work for some time endeavoring to formulate the professional and ethical principles involved in underestimating. The subject was originally brought up, we are informed, by the case of a large piece of public work whose construction was authorized on the basis of an official estimate by the engineer in charge, but which required large additional appropriations later on because the actual cost overran the estimate very greatly without much change in labor and material prices. The case was recognized as being typical of many similar cases of underestimating, and therefore was referred to the association's Practice Committee, a standing committee charged with the quasi-judicial function of passing upon the ethical propriety of professional cases brought before it by the directors of the association. While the committee has not yet made a finding in the case, we are advised by the secretary that the following points are being considered: What are the engineer's moral obligations in the preparation of cost estimates; what professional and political conditions are responsible for the prevalence of inadequate estimates and how may warning against them be formulated; and, finally, are there any circumstances under which an estimate that proves grossly incorrect does *not* represent a violation of good principles of professional conduct? Questions of this kind are not simple, and their answer ought to base on a wide range of data. All interested are invited to communicate their views to the association. Just at present, as we pointed out last week, the engineering profession seems to be acquiring a rather doubtful reputation for skill (or the opposite) in estimating costs. Let us find out whether the fault lies in vision, in courage or in ethics; and in particular, if loose ethics are responsible let us find out quickly and with certainty.

Drought Again Favors Teredo

FOUR years ago there was a long drought on the mid-Pacific coast which reduced the flow of the rivers and permitted a backflow of sea water to much higher river and harbor points than had been before recorded. There followed the unprecedented destructive activity of the teredo and other salt water borers in riparian timber structures. This destruction ran into millions of dollars and was so sudden and pronounced as hardly to be noticed until complete failure of supported piles and timber had resulted. The study of marine borers, recently completed and detailed in the book by Col. Atwood and Mr. Johnson, was the direct result of this phenomenon. Word now comes from the Pacific coast that the history of 1920 is being repeated. This year is also a year of low rainfall and the Pacific rivers, like the Sacramento, have salt content far higher than normal. The salt loving teredo has followed the sea water and his appetite is being satisfied on the timber of piers. At Martinez and Benicia, in upper San Francisco Bay, wharves have already collapsed and others are reported to be in a dangerous condition. The lesson is plain that wherever the salinity of river water is apt to be increased by drought every precaution to discourage the teredo and his ilk must be taken.

Standardized Contract Forms

MUCH effort has been put into the formulation of a standard engineering contract by the Joint Conference whose work is reported on another page of this issue. The document which has been finally evolved, as well as the companion one on buildings, represents a boiled down but comprehensive contract form which embodies in concise, legal and unmistakable language the provisions necessary to a binding contract between owner and contractor. While in the two-year discussion prior to its adoption by the conference there were doubtless many subjects of dispute, the only real issue which involved a major principle was the matter of arbitration. Except for that issue the form can be accepted by any of the interests which enter into construction contracts.

Arbitration, however, is a sore subject with most engineers. Traditionally the engineer is the final authority in the execution of a contract. In spite of the fact that the engineer is always hired by the

owner, a party to the contract, he has been able to build up for himself the somewhat anomalous position of an unbiased judge in any controversy between the two parties to the contract, the owner and the contractor. There is no use denying that the engineer has frequently abused the advantage thus given him, that he has more often than not become an advocate of the owner rather than a non-partisan adjudicator and that in taking the position that he is hired to see that the contractor fully executes the contract he has a tendency to believe that the contractor is always trying to evade his just obligations. This state of mind is not conducive to fair judgment.

On the other hand the work the constructor contracts to build is the plan of the engineer and he, and he only, should be the judge of whether that plan is being followed. Under no other theory could contract work be carried out. If the contractor were permitted his own judgment as to the meaning of a drawing or a method of execution, or if he were permitted the recourse of arbitration in such technical details, no contract would get beyond the first stage, so frequent would be dispute and so expensive and delaying the summoning of arbitrators.

It is exactly such a view that the new contract forms take. The engineer is made supreme in all matters except those of time and financial consideration. In other words the work must go on exactly as the engineer orders and if this order is offensive to the contractor his only recourse is a demand for arbitration which will decide whether the order required an undue time or an excessive cost beyond the time and cost reasonably laid down in the contract.

This seems a fair provision—as a general proposition. And, indeed, its abuse will be automatically limited, for any contractor who too frequently or carelessly invokes arbitration will soon find himself on a blacklist. Further than that the decision of arbitrators ought to build up a sort of common law or precedent which will serve as a warning in future work.

But regardless of the value of the new contract forms, it is doubtful if the engineering societies represented in the conference will adopt them as standards. Engineers, unlike architects, are individualistic in matters of this sort. The architect tends to uniformity in what he regards as the minor practices of his art. All of his individuality he lavishes on the final form of his structure. In the method of executing that individual expression he is willing to borrow from his fellows or to utilize any or all standardized methods that are available. The engineer, on the other hand, has too often to build a standardized structure, individualized as to detail, to be sure, but very like the others of its class. His individualism is in method and he is most jealous of that method. This jealousy extends even to contract forms, which he insists on writing himself even though he sometimes does most of the writing with paste pot and shears. For him to buy a printed contract form, as his brother the architect does so freely that the American Institute of Architects realizes $10,000 a year from sale of forms, would be a sinking of personality he would not contemplate.

So there is reason to doubt that the engineering contract form will be adopted by any engineering society or sold in great number to be used "as is" by engineers. But each of the societies contributing to the conference can well endorse the contract form recommended, can print the form in their proceedings as a guide to each of their members and can recommend that the principles there set forth and the manner of their setting forth be used as models, in following which true engineering individualism may be allowed its proper sway.

Is Labor Efficiency Increasing?

IN THE bonanza days of the war when anyone could get a job at any trade construction labor learned lazy habits and acquired untrained members, and the two together so reduced morale that output fell alarmingly off. No small part of the increased cost of those first post-war years was due to the labor slacker who would not or could not give a fair day's work for what even the most pessimistic of his kind would admit was a fair day's pay. It took several years for this pernicious influence to wear off; indeed there are those not sympathetic to labor who refuse to admit that it ever wore off. But the more honest of employers do admit that construction labor is getting back into its stride and that though wages still stay high there is a disposition for the workman to render his best service for his high wage.

This impression of a better labor efficiency, however, is confined mostly to an impression because most labor employers have no definite measure of output or if they have such measure do not see fit to make it public. It is noteworthy, therefore, that one such large employer, the Turner Construction Co., is willing to give public testimony to its record of an increased unit output of labor in its special field, concrete building construction. It has a record of comparable work on which it has established an index of labor output. Calling the unit output of the years 1915-16 as 100, the index for the succeeding years are as follows: 1920, index 90; 1923, index 112 and 1924, index 120. In other words their laborers are doing an average of 20 per cent more work than in 1915 and 30 per cent more than the post-war 1920.

The figures have been further subdivided by trades for 1924 as follows: labor stripping and handling forms, 166; labor concreting, 131, lathers placing reinforcement, 118; carpenter work on forms, 109; carpenters and laborers making forms, 98; labor receiving and distributing reinforcement, 90 and cement masons, 83. As a last note the company says that the bricklayer production has been unsatisfactory due to the enormous demand, with bonuses and consequent inefficiency, but this has recently improved although the brick laid per man per day are not yet up to pre-war standards.

This is all very encouraging. Contractors often remark that they do not complain about high labor costs so long as they get their money's worth from the men. It seems evident that except where scarcity demand has undermined all individual sense of obligation, labor in the construction field is getting back to production, which is the first step toward stability in the whole industry. Nor should the fact be neglected that for such improvement as is shown in the foregoing figures the management is partly responsible. Labor can be more efficient if it is more efficiently directed and complaints about low unit production should call first for a study of how the men are being led and the way their work is being laid out for them.

Design of the Florianopolis Suspension Bridge

New Stiffening Truss Produces More Rigid Bridge With Less Material—Main Chains Made of Heat-treated Eyebars With Yield Point Above 75,000 Lb. per Sq.In.—Towers Designed to Rock on Base

By D. B. Steinman
Consulting Engineer, New York

THE FLORIANOPOLIS Bridge (main span 1,113 ft. 9 in.), now under construction in Santa Catharina province, Brazil, will be the longest-span bridge in South America and the longest eyebar suspension span in the world. In addition, the structure will be of interest to engineers as the first example of a new departure in suspension design, and as the first application of an important new structural material.

Holton D. Robinson and the writer prepared the design, as consulting engineers for Byington & Sundstrom, of São Paulo, Brazil, who had already secured the general contract from the State of Santa Catharina. Minimum cost was the outstanding requirement governing the design.

New Form of Stiffening Trusses—The form of stiffening construction adopted for the Florianopolis bridge departs rather radically from precedent. The following considerations led to its conception:

In the central portion of the conventional form of suspension construction, the cable, which sustains a heavy tensile stress, is in close proximity to the upper chord of the stiffening truss, where compression is the governing stress. Such juxtaposition of two principal elements carrying opposing stress represents a waste of material, or, rather, a neglected opportunity for increasing economy. By combining the two opposing structural elements a great saving can be effected: the result is a subtraction of stresses instead of an addition of sections. There is thus secured a partial neutralization of the maximum tensions in the middle portion of the cable, and the corresponding portion of the upper chord of the truss is dispensed with.

This utilization of the cable as the upper chord of the stiffening truss should be limited to the middle portion of the span. To extend this construction to the ends of the span would not be economical, because the saving of the top chord in the outer quarters would be offset by the increase in length of the web members in a region where the stiffening truss has its maximum shears. Moreover, beyond the quarter points there would be an addition instead of a subtraction of stresses, since the condition of loading that produces maximum tension in those top chords is one that produces nearly maximum tension in the cable.

Another neglected opportunity for increasing economy and efficiency in the conventional form of suspension construction is represented by the use of parallel-chord stiffening trusses. For maximum economy the truss should have a profile conforming to the variation of maximum bending moments along the span, a principle which receives recognition in the design of other structures, such as simple trusses, cantilevers, continuous trusses and arches. Since the economic depth at any section is a function of the governing bending moment, a truss should have its greatest depth at the points of greatest bending moment, and should be made shallow where the bending moments are comparatively small. In a suspension-bridge stiffening truss, the greatest bending moments occur near the quarter-points of the span; consequently the economic profile of a stiffening truss is one having maximum depth near the quarter-points and minimum depth at mid-span and at the ends. This conclusion is strengthened by the fact that the shears in a stiffening truss are a minimum near the quarter-points and attain maximum values at the middle and ends of the span, so that a truss-profile with maximum depth near the quarter-points also gives economy in web members since it provides the shallowest depth in the regions where the web stresses are greatest. Such a profile yields the additional advantage of greater uniformity of required chord-sections throughout the span. A wide range of variation in required sections generally involves a waste of material in those chord members where minimum sections are required.

Another consideration governing truss-depth is that of efficiency in reducing deflections. The most serious deflection of a stiffening truss, as measured by the resulting deflection gradients, is produced under the condition of live-load covering approximately one-half of the span. Half-span loading produces a downward deflection of the loaded segment and a somewhat smaller upward deflection of the unloaded segment, with a maximum deflection gradient at the loaded end. The magnitude of this deformation depends upon the truss-depth at and near the quarter-points. Calculations show that to limit the deflection gradient to 1 per cent a truss depth of 1/45 to 1/40 of the span is required. A parallel-chord stiffening truss of such depth (as illustrated by the Williamsburg bridge) would render the structure unsightly. In order to secure the requisite stiffness without resorting to a stiffening truss of clumsy proportions, we must abandon the parallel-chord type and adopt an outline providing the extreme depth only where it is needed, namely in the vicinity of the quarter-points of the span.

The foregoing considerations show that the logical directions for improvement of conventional suspension design for increased economy and efficiency are along two lines: (1) Utilization of the cable as the top chord of the stiffening truss (preferably limited to the middle half of the span); and (2) variation of truss profile to give maximum depth near the quarter-points of the span. The two requirements, fortunately, are congruous; complying with the first automatically facilitates compliance with the second. The result is the new form of suspension construction adopted for the Florianopolis bridge.

Comparative Economy—The bridge had already been designed along conventional lines, when the decision to substitute eyebar chains for wire cables prompted consideration of the revised truss design and facilitated its application. Fig. 1, comparing the adopted design with the layout which it superseded, shows the essential features of the new form of construction. The parallel-chord stiffening truss was 25 ft. deep throughout; the revised layout, utilizing part of the cable (or chain)

as top chord, provides a truss with depth varying from 22.5 ft. to 42.5 ft.

In the first sketches for the new design, the upper chord in the outer quarters of the span was made curved so as to produce an effect of symmetry about the quarter-points. This yielded a most pleasing outline. Straight chords were substituted, however, in deference to the preference expressed by our client.

Comparative cost-estimates of the two designs shown in Fig. 1 demonstrate a material saving in favor of the new design. In addition to the major elements of economy outlined in the preceding general discussion, there are a number of incidental savings arising from the change in design. The new form of construction yields the following contributions to a reduction in the total cost of the structure:

(1) Saving the material represented by the middle half of the top chord of each stiffening truss; (2) a general saving in the remaining chord material resulting from the use of an economic truss-profile conforming to the variation of bending moments along the span, and in particular, a material reduction in the maximum chord-sections previously required in the vicinity of the quarter-points of the span; (3) a saving in details and in minimum sections resulting from the greater uniformity of required chord-sections throughout the span; (4) a saving in web material on account of the reduced truss-depth in the regions of maximum shear; (5) dispensing, in the middle half of the span, with the subverticals previously required to half-length the compression-chord members which are now replaced by tension members; (6) dispensing with the intermediate top laterals previously required to half-length the same compression-chord members in a horizontal plane; (7) as a result of these various savings, a reduction of about one-third in the total weight of the stiffening truss, and a consequent saving in all portions of the structure affected by the dead-load of the truss; (8) a saving in chain (or cable) sections resulting from the reduced dead-load of truss and the consequent reduced dead-load of chain; (9) saving of the suspenders in the middle half of the span and a reduction in length of the remaining suspenders; (10) a reduction (6.5 ft. in the case of the Florianopolis bridge) in the total height of the towers in consequence of the reduced distance between cable and lower chord; (11) a saving in the towers resulting from the reduction in height combined with the reduction in dead-load of truss and chain; (12) a material saving in the anchorages resulting from the reduced dead-load of truss and chain and the reduced elevation of the backstays.

In the case of the Florianopolis bridge, a large portion of the economy yielded by the change of design was not capitalized but was turned back into the structure in the form of reduced unit stresses to provide a greater margin of safety for future load-increase. Thus the design stress for the stiffening truss was reduced from 20,000 to 18,500 lb. per sq.in. (actually 14,000 as calculated by the exact method); and the unit stress in the chain was reduced from 50,000 lb. per sq.in. to 46,500.

Fig. 2, condensed from the general stress-sheet of the final design, presents the principal features of loading, stresses, dimensions and sections.

Rigidity of the Design—While the governing consideration in the change of design was that of economy, the change yielded greatly increased rigidity as an incidental advantage. The deflection graphs calculated for the adopted design are submitted in Fig. 3. According to these graphs, the maximum deflection under full-span loading is only 1.88 ft. or 1/592 of the span; and the maximum deflection under half-span loading is only 1.36 ft. or 1/820 of the span, with uplift in the unloaded half practically eliminated. The actual deflections will be about 25 per cent less than these calculated values, since the calculations were based on the "approximate method" and since no allowance was made for the stiffening effect of details. These deflections are approximately one-fourth of the corresponding values for the previous (conventional) design. Since the Florianopolis bridge is designed to carry a railway as its principal element of live-load, this reduction of the governing deflections is of practical significance.

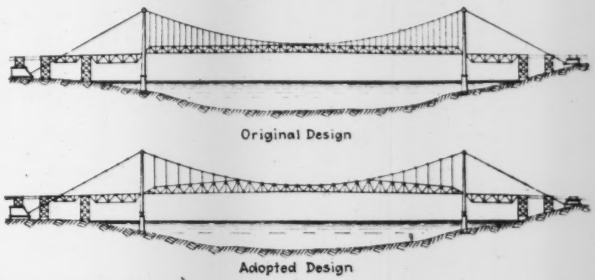


FIG. 1—ORIGINAL (PARALLEL-CHORD) AND ADOPTED (CURVED-CHORD) DESIGNS FOR FLORIANOPOLIS BRIDGE
Adopted design secures great increase of rigidity with less material than required for parallel-chord design

About 25 per cent increase in rigidity may be attributed to the substitution of eyebars for wire cables; the remainder of the 300 per cent increase is the direct consequence of the new form of stiffening construction.

The following elements of the new design contribute to this increase in rigidity: (1) The revised truss-profile is more efficient in resisting deflections, since it provides maximum depth in the regions of greatest bending moment; (2) the depth at the quarter-points has been made nearly twice as great as in the previous design, and the stiffness in the vicinity of the quarter-points is the principal factor in determining the rigidity of a suspension bridge under the critical condition of half-span loading; (3) the functioning of the full section of the cable as top chord of the stiffening truss in the middle-half of the span greatly increases the moment of inertia in that portion of the span; (4) the fact that live-load introduces tension in the middle half of the top chord (by virtue of its forming part of the cable) further reduces mid-span deflections.

As a result of these various factors, the change of design yields greater stiffness with less material in the structure. In approximate figures, the design is four times as rigid with only two-thirds as much material in the stiffening truss. Thus, greater efficiency has been secured through a more scientific design of the suspension stiffening system.

In addition to the marked increase in vertical rigidity yielded by the new design, the lateral stiffness is improved by the large cable (or chain) sections functioning as wind-chords in the middle-half of the span; and ideal longitudinal rigidity is secured by the direct connection of the truss to the cables. Longitudinal or braking forces are carried directly into the cable without producing bending moments in the towers.

The net result of the change in design as applied to the Florianopolis bridge is a reduction in cost (through actual saving in material), an increase in safety and longevity (through lower unit stresses), and an increase in efficiency (as measured by resistance to deflections).

Erection Considerations—Designs have been proposed, in the past, in which the cable (or chain) would be utilized as the top chord of an overhead bracing system. It is believed that the Florianopolis design is the first one in which the desired advantages are secured while retaining a stiffening truss at roadway level from tower to tower. The use of an overhead trussing system (departing from roadway level) necessitates separate wind-chords for lateral stiffening, and would incur a number of other disadvantages; the principal disadvantage would be the increased difficulty of erection. With the truss at roadway level, as in the Florianopolis design, erection can proceed exactly as in the conventional type of suspension structure, namely with the travelers advancing along the roadway deck.

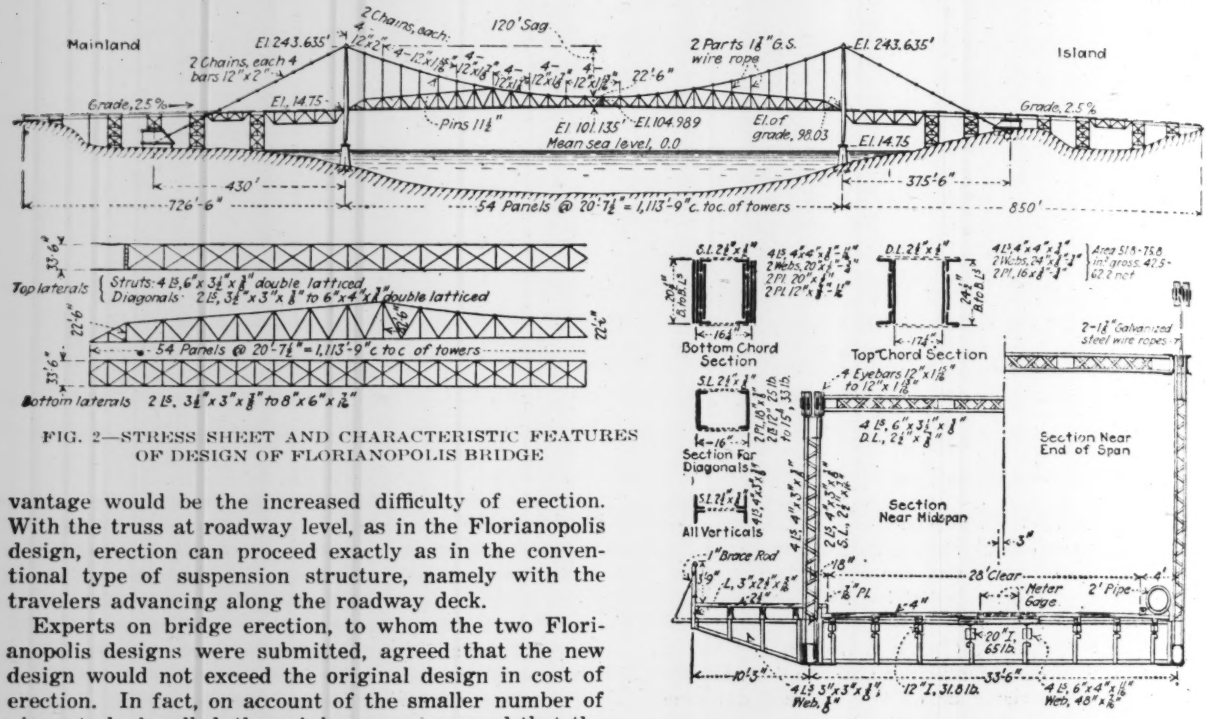

Mainland
Island
2 Chains, each 4 bars 12" x 2"
El. 243.635'
120' Sag
2 Parts 1⅛" G.S. wire rope
Grade, 2.5%
El. 14.75
Pins 11½"
El. 101.135'
El. 104.989
Mean sea level, 0.0
El. of grade, 98.03
430'
726'-6"
375'-6"
850'
54 Panels @ 20'-7½" = 1,113'-9" c. to c. of towers
Top laterals
Struts: 4 13, 6" x 3½" x ⅜" double latticed
Diagonals: 2 15, 3½" x 3" x ⅜" to 6" x 4" x ⅜" double latticed
Bottom laterals 2 15, 3½" x 3" x ⅜" to 8" x 6" x ⅞"
Bottom Chord Section
Top Chord Section
Section Near End of Span
Section Near Midspan
Section For Diagonals
All Verticals
4 Eyebars 12" x 1⅛" to 12" x 1⅜"
2-1⅜" Galvanized steel wire ropes
1" Brace Rod
⅜" PL
Meter Gage
2' Pipe
28' Clear
12" I, 31.8 lb.

FIG. 2—STRESS SHEET AND CHARACTERISTIC FEATURES OF DESIGN OF FLORIANOPOLIS BRIDGE

Experts on bridge erection, to whom the two Florianopolis designs were submitted, agreed that the new design would not exceed the original design in cost of erection. In fact, on account of the smaller number of pieces to be handled, the opinion was expressed that the cost of erection should be reduced.

The only new difficulty in the erection arises from the absence of suspenders for adjustment in the middle half of the span. Adjustment of the remaining suspenders, however, suffices for the manipulation of the truss in order to permit connections to be made and in order to bring the truss to a final unstressed condition. Moreover, no difficulty has been experienced in the erection of suspension bridges in which no hanger adjustments were provided. With careful triangulation and fabrication, and with accurate knowledge of the elastic properties of the materials, provision for hanger adjustment can be dispensed with in modern suspension design.

However, the erection contractor decided to leave some of the truss-members with blank connections to be drilled in the field as a safeguard against contingent difficulties. On this account (also to cover drafting-room expense for revision) a charge was made in the erection contract for the privilege of changing the design; but this extra charge was relatively small and amounted to only a minor fraction of the saving in cost effected by the adoption of the new design.

Heat-Treated Eyebars—In the Florianopolis bridge a new material, in the form of high-tension, heat-treated carbon-steel eyebars, finds its first application. This material, intended to be used with a working stress of 50,000 lb. per sq.in., has been developed through recent experimental research by the American Bridge Co. It is furnished under guarantee of minimum elastic limit of 75,000 and minimum ultimate strength of 105,000 lb. per sq.in., and minimum elongation of 5 per cent in 18 ft.

Cables of parallel wire, with long-lay steel rope strands as an alternative, were specified in the original design. After bids had been secured in this country and abroad for steel wire and for rope strands, the American Bridge Co., through the U. S. Steel Products Corp., submitted the suggestion of substituting chains of heat-treated eyebars. They offered to furnish the material and erect the chains at a price which equated the total cost to the estimate based on the lowest bid received for wire. This proposal was attractive to the general contractor, particularly as it relieved him of the cable-erection contract, and the new material was accepted.

When fabrication of the eyebars was commenced, we learned that our client had waived the privileges of inspection, and that the bridge company maintained a policy of secrecy covering the material and the processes of treatment. There was no way for the engineer to assure himself of the uniformity of the product. Full-size tests were, of course, provided; but even these were inconclusive since they were made on eyebars especially fabricated for these tests. Selections by the engineer from the finished lots of eyebars could not be used for the tests because, with few exceptions, the eyebars exceeded in length the capacity of the testing machine. Cutting and re-heading of selected bars exceeding the

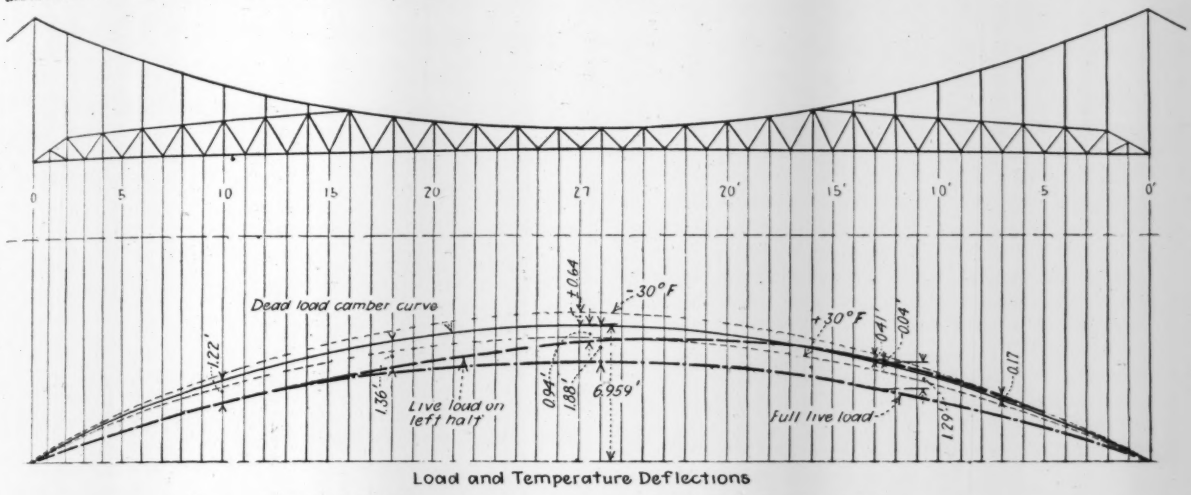
40-ft. length-limit was precluded as the operations would disturb the qualities produced by the previous heat-treatment. To every suggestion advanced by the engineers toward securing a verification of the uniformity or reliability of the eyebars fabricated for the structure, some objection was advanced; and the bridge company maintained its position that the eyebars were being furnished under its contractual guarantee. Under these circumstances there was nothing left for the consulting engineers to do but to decline to assume any responsibility for the strength and safety of the eyebars furnished for the structure; and the matter was left with the understanding that the bridge company assumed sole responsibility for this material.

temperatures) on the basis of its chemical analysis and sectional dimensions.

A medium grade heat-treated steel (with 50,000 elastic limit) has been used in recent years for eyebars in several structures with satisfactory results.

The new material (high-tension, heat-treated steel with 75,000 elastic limit) offers attractive advantages to the structural engineer. For its more general adoption, however, the confidence of the engineering profession must be secured; and this awaits the satisfactory solution of the present problems of inspection restriction and test limitation.

A novel detail was adopted for the Florianopolis eyebars in the form of oval pin-holes. The hole is made



Load and Temperature Deflections

FIG. 3—DEFLECTIONS UNDER LIVE-LOAD AND TEMPERATURE

Apart from the unsatisfactory circumstances at present surrounding the furnishing of these eyebars in respect to limitations of inspection and testing, the material appears to be fairly satisfactory so far as can be judged from the reported tests. In nine full-size tests made during the period of experiment prior to the offering of the material for the Florianopolis bridge, the elastic limit ranged from 78,500 to 89,800 with an average value of 83,920; the ultimate strength ranged from 113,900 to 132,600 with an average value of 123,200; the elongation in 10 ft. ranged from 6.1 to 9.2 per cent with an average value of 7.2; and the contraction of area ranged from 16.5 to 39.2 per cent with an average value of 24.6. In thirteen full-size tests made during the fabrication of the eyebars for Florianopolis, the elastic limit was 78,180 minimum, 96,830 maximum, 84,560 average; the ultimate strength was 114,660 minimum, 137,900 maximum, 122,990 average; the elongation in 18 ft. was 3.8 minimum, 8.1 maximum, 6.7 average; and the contraction of area was 7.6 minimum, 32.3 maximum, 23.9 average. Only one eyebar failed to meet the specified requirements, yielding an elongation of only 3.8 per cent; a new eyebar was made up for "re-test" and passed the requirements with 8.1 per cent elongation.

Since the previous experimental work had been confined to eyebars of 12x2-in. section, the eyebars for Florianopolis were made to conform to this section as nearly as possible, ranging from 12 by $1\frac{1}{8}$ to 12 by 2.

It is claimed that each eyebar requires individual adjustment of heat-treatment (with respect to time and somewhat elongated (axially) and enlarged in back to facilitate entry of the pin, while retaining close fit in the segment of contact. The front or bearing semicircle exceeds the diameter of the pin ($11\frac{1}{2}$ in.) by only 5/1,000 in.; the rear semicircle is bored to the diameter of the pin plus $\frac{1}{32}$ in. and the two centers are separated $\frac{1}{8}$ in. along the axis of the eyebar. The unusually close fit thus secured along the bearing surface reduces the secondary stresses in the eyebar head. This detail is copyrighted by the American Bridge Co.

The $11\frac{1}{2}$-in. pins for connecting the 12-in. eyebars are of special heat-treated steel, with a yield point ranging between 60,000 and 65,000, and a tensile strength ranging between 100,000 and 105,000. A few pins are of chrome-nickel steel, of same strength values.

Design of Towers—The Florianopolis bridge will be the first American suspension bridge built with rocker towers. The only large bridges previously built with this feature are the Elizabeth bridge at Budapest (1903) and the bridge over the Rhine at Cologne (1915).

The rocker type offers the most economical and scientific design for suspension bridge towers. It eliminates the bending stresses from unbalanced cable pull, thereby yielding a saving in tower material, and it eliminates the difficulties of the necessary erection operation of pulling back the tops of the towers prior to stringing the cables or chains.

In the case of the Florianopolis bridge, the change was made from fixed-base towers after comparative estimates showed a net saving of about 20 per cent in the cost of the towers in favor of the rocker type.

There is a material reduction in the main sections by the elimination of the bending stresses.

A general drawing of the towers was given in a previous article (*Engineering News-Record*, Oct. 11, 1923, p. 592). The pedestal casting is finished to a plane top surface 27x45 in. The rocker casting is finished on its lower or bearing surface to a radius of 12 ft. The line of contact is 45 in. long. For security against creeping displacement, four screw-dowels of 3 in. diameter are provided. The rocking of the upper casting on the lower was tested in the shop with the dowels temporarily in place. The bottom face of the pedestal casting is cast with two full-length diagonal lugs which engage corresponding grooves in the masonry to prevent any possible sliding of the casting.

The maximum vertical reaction on each rocker-bearing is 2,000 tons.

Bridge Cross-Section—The bridge was required to carry a 28-ft. roadway, a meter-gage electric railway, a 24-in. water main, and a 9-ft. sidewalk. The adopted arrangement of cross-section is shown in Fig. 2. The cables and trusses are spaced 33½ ft. center to center; the sidewalk is carried on an outside bracket along the north truss, and the water main is located just inside the south truss so as to help equalize loads.

On account of the inherent stability of the suspension construction, sway-bracing is dispensed with. Adequate systems of lateral bracing have been provided.

Anchorages—The east anchorage, on the island of Florianopolis, is located on rock. The anchor chains and reaction girders are embedded in concrete in two stepped trenches excavated in the solid rock; the sides of these trenches were given a negative batter to increase the vertical resistance; and on this construction is superimposed the buttressed concrete anchorage structure. The west anchorage is situated on lower ground on the mainland. The excavation did not reveal rock where anticipated, and a pile foundation had to be used; about 25 per cent of the piles (located under the forward portion of the anchorage) are battered in the direction of the resultant pressure. Both anchorages are U-form in plan, for maximum efficiency.

Each anchor-chain, consisting of heat-treated eyebars, divides into two branches for connection to the anchor girders. Each anchor girder, 16 ft. long, consists of five built-up girders connected together by tie-plates and reinforced with pin-plates. At the Y-point of each anchor chain, a built-up pin-seat was provided to hold the pin in accurate position during the placing of the concrete around the anchor girder and the connecting eyebars. Above these points, the anchor chains were boxed-in during the completion of the concreting in order to prevent adhesion of the concrete until full dead-load strain is in the chains.

Loads and Stresses—The dead-load used in the design of the main span totaled 4,370 lb. per lin. ft. (chains 770 lb., and suspenders, trusses and bracing 1,530 lb., floor 1,670 lb., water pipe 400 lb.). The live-load was taken at 2,000 (plus 10 per cent) and 1,850 lb. per lin. ft. for the design of trusses and chains respectively. The floor was proportioned for a 50-ton electric locomotive followed by 2,000 lb. per lin. ft., plus 50 per cent impact, a 6-ton motor truck (or 60 lb. per sq.ft.) with 25 per cent impact, and a sidewalk load of 60 lb. per sq.ft. Wind was taken at 25 lb. per sq.ft. (30 lb. on viaduct), and temperature variation at ±30 deg. F. With these loads the floor steel was designed for a stress of 17,000 lb. per sq.in., the towers and trusses for 18,500 (increased 25 per cent for temperature and wind addition), the suspenders for 55,000, and the chains for 46,500.

The following typical stresses and sections of stiffening truss members are quoted from the stress sheet (panel-point being at the tower, 16 at the junction of top chord with chain, and 27 at midspan). Stresses are given in thousand-pound units per truss.

Top chord 6-8—DL, 0; LL + I, 372t, 776c; T, 57; W, 155t, 223c; total, 584t, 1056c. Makeup, two webs 24x⅜, four outside angles 4x4x⅞, two outside plates 16x⅜ in.

Top chord 14-16—DL, 0; LL + I, 244t, 755c; T, 71; W, 385t, 425c; total, 700t, 1251c. Makeup,two webs 24x⅝, four outside angles 4x4x⅞, two outside plates 16x¾ in.

Top chord 26-26—DL, 2823t; LL + I, 318t, 332c; T, 196; W, 527t, 527c; total, 3864t. Makeup, four bars 12x1½ in.

Bottom chord 5-7—DL, 0; LL + I, 730t, 364c; T, 52; W, 244t, 311c; total, 1026t, 727c. Makeup, two webs 20x⅞, four inside angles 4x4x⅞, two outside plates 20x½ in.

Bottom chord 15-17—DL, 0; LL + I, 717t, 220c; T, 71; W, 514t, 548c; total, 1302t, 839c. Makeup, two webs 20x¾, four inside angles 4x4x1⅛, two outside plates 20x½ in.

Bottom chord 25-27—DL, 0; LL + I, 1180t, 33c; T, 165; W, 615t, 615c; total, 1960t, 813c. Makeup, two webs 20x¾, four inside angles 4x4x1⅛, two inside plates 12x1⅛, two inside plates 18x⅝, two outside plates 20x½ in.

Diagonal 6-7—DL + LL + I, 126t, 61c; T, 7. Makeup, two channels 12 in., 25 lb.

Diagonal 15-16—DL + LL + I, 198t, 186c; T, 1. Makeup, two channels 15 in., 33 lb.

Diagonal 26-27—DL + LL + I, 218t, 192c. Makeup, two channels 12 in., 25 lb.

Verticals—DL + LL + I, 93t. Makeup, four angles 4x3x⅝ in.

General Data—The bridge is being built by the Brazilian state of Santa Catharina to connect its island capital of Florianopolis with the mainland. The contractors are Byington & Sundstrom of São Paulo. The United States Steel Products Corp. has the subcontract for furnishing and erecting the steelwork. The substructure, including the foundations, piers, anchorages and abutments, was completed several months ago by the principal contractors. The steelwork has been fabricated and shipped, and erection is in progress. It is expected that the bridge will be completed in the summer of 1925. Robinson & Steinman, of New York, are the consulting and designing engineers. L. N. Gross has been associated with them as consulting engineer on the construction.

A preliminary article on the design of the Florianopolis bridge was published in *Engineering News-Record*, Oct. 11, 1923, p. 592, and an illustrated account of the construction of the piers and anchorages appeared in the issue of July 10, 1924, p. 51.

The approximate weight of steel in the bridge (including approaches) is 4,400 tons, made up as follows:

	Tons
Chains—Eyebars and pins	780
Main Span—	
Trusses and bracing	840
Floor system	400
Main Towers—	
Columns and bracing	850
Castings	90
Anchorages—Eyebars and girders	130
Approaches—	
Spans (incl. floor and bracing)	940
Towers and bracing	290
Miscellaneous—Railings, etc.	80
Total	4,400

The approximate total quantity of concrete in the island anchorages is 2,350 cu.yd., in the contingent anchorage 5,250 cu.yd., and in the piers and abutments 5,000 cu.yd., a total of 12,600 cu.yd.

Modern Gas and Bell Buoy Built by Lighthouse Service

Bell Operated by Carbonic Acid Gas—Flashing Acetylene Gas Light—Buoy Designed to Minimize Rolling

FOG SIGNAL apparatus for all buoys, whether in the form of whistle buoys, aerial bell or submarine bell buoys, heretofore was actuated by the wave motion of the surface of the sea. During periods of calm weather such apparatus is not very effective. To overcome this defect and at the same time to improve the lighting facilities the Lighthouse Service of the Department of Commerce has built an improved type of buoy for use in channels where it is essential that mariners be able to run close to the aids to navigation without fear of damaging their vessels. These new buoys are not designed to supplant lightships. Their design is based upon the experience of engineers in this and other countries and on the experience of manufacturers of lighthouse equipment.

A buoy of this type has been installed at the entrance to Chesapeake Bay. It is known as the Tail-of-the-

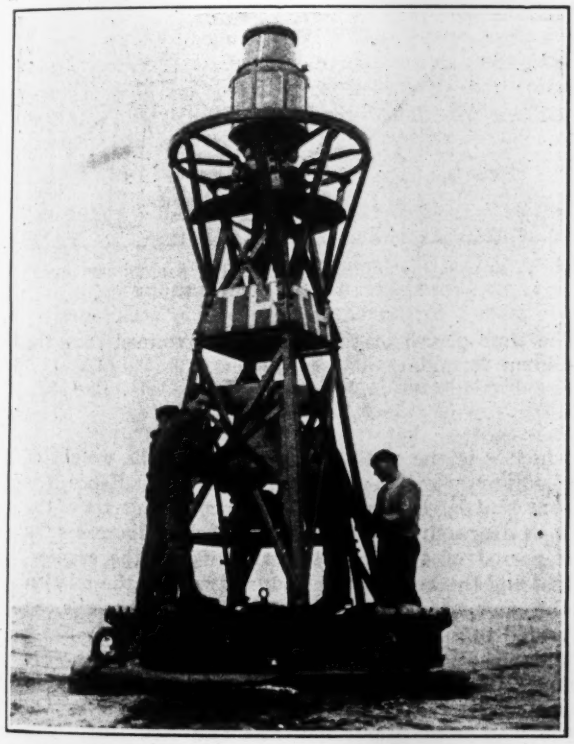


FIG. 1—LIGHT AND BELL BUOY, CAPE HENRY, VA.

Horseshoe Buoy, T.H. In this new type the 1,000-lb. bell is rung by a striker operated by compressed carbonic acid gas. The striker is mounted on the outer end of a plunger set in a cylinder below the bell. Gas from storage cylinders in the body of the buoy filters through an asbestos packed choke valve to a chamber where it is retained until a pressure of 19 atmospheres is built up, when it is released to the cylinder behind the striking plunger to expand and drive the striker against the bell. The flow of gas is so regulated that the piston is operated every 15 sec. or 175,000 times a month. The buoy contains sufficient carbonic acid gas for 800,000 blows or a running time of four months without attendance. The gas is stored in tanks of 100 lb. capacity each, four tanks being installed in a cage in each of three of the four pockets in the buoy.

The lighting of buoys has reached a stage of development where it is feasible to moor a buoy off the coast for a period of a year without attention and have it show a light of 480 cp. with a distinctive characteristic having a luminous period of 10 per cent of the time. Acetylene gas is used for the illuminant. In the Tail-of-the-Horseshoe Buoy, T.H., the gas is stored in an accumulator having a capacity of 1,088 cu.ft. at 12 atmospheres pressure, which is wedged in the fourth tank pocket in the buoy body. The accumulator weighs 1,550 lb. and is filled with a porous mass permeated with acetone which stores the acetylene in the dissolved state and makes it safe to handle.

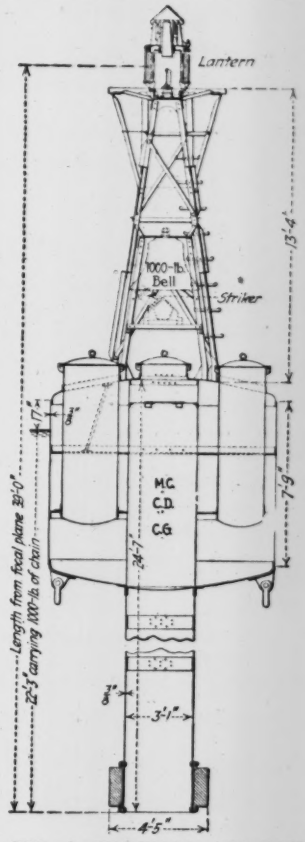


FIG. 2—VERTICAL SECTION THROUGH THE BUOY
Weight fully equipped 35,500 lb.

The lantern is supported on top of the tower on the buoy with the focal plane 16 ft. above sea level. The lens is 375 mm. in diameter and the lantern weighs 620 lb. It is equipped with an acetylene flasher having a 1½-ft. steatite burner yielding a candlepower of 480 through the lens and set to flash every 2 sec., each flash being of ½ sec. duration.

To carry this lighting equipment, weighing 2,400 lb. and the fog signal apparatus, weighing 6,100 lb., required a special buoy larger and heavier than heretofore used. The general dimensions and details of the buoy are given in Fig. 2. It is designed to protect the delicate mechanism as well as to stand the shock of the open sea. In addition, as the buoy is handled by the derrick equipment of a lighthouse tender and usually in a seaway, every consideration was given to the ease and facility for raising it. The weight was limited to 18 tons and the over-all length to 40 ft. in order that the buoy might fit the equipment and deck space of the present first-class buoy tender. The arrangement of tanks and piping was carefully considered to permit recharging with minimum loss of time and it permits the testing of all connections for gas leaks.

Design Requirements—The design of a gas buoy to be moored in open sea offers an interesting problem of many exacting requirements. Since the gas buoy is equipped with a light of distinctive characteristic, it is essential that every flash be visible from all points on the horizon even in a heavy sea. The fresnel

lens gathers up the light rays and refracts them into a plane perpendicular to the vertical axis of the buoy. As the buoy deviates from the perpendicular, the plane of light moves from the horizon. Since the light source is not a pin point source in the focus of the lens the light which is not in focus diverts the refracted rays from the horizontal plane. The angle of vertical divergence can be ascertained and the buoy can be given seaworthiness that will limit the deviation of the buoy from the perpendicular to an angle less than one-half the angle of divergence of light, thus each flash is visible on the horizon.

A sea buoy properly designed deviates only slightly from the perpendicular, inclining towards the crest of the wave instead of towards the trough. This is accomplished by giving it considerable weight, and a deep draft with the weights placed high on the superstructure and counterweighted, thereby producing characteristics of minimum required tendency to overturn or moment of rigidity, maximum moment of inertia and long pendulum period. As contrasted with vessel design in which ships are given stability by virtue of their shape, a buoy is in stable equilibrium by virtue of the fact that the centre of gravity is lower than the center of buoyancy.

Having determined the weight of the buoy, the displacement, free board, center of gravity and center of buoyancy, the metacenter above the center of buoyancy may be determined from the formula $H = I/D$ in which H is the metacentric height, I the moment of inertia at the floating water surface and D the displacement. In the buoy under discussion:

$$I = \frac{\pi d^4}{64} = 490.87$$

in which d is 10 ft., the diameter of the buoy; D, the displacement, is 555 cu.ft., and H the metacentric height figures 0.887 ft.

The tendency to overturn, called here the moment of rigidity, may be expressed as follows:

$$M_R = D \times m \sin a$$

in which D is displacement, m the distance from the center of gravity to metacenter and a the heeling angle. In the buoy under discussion $D = 555 \times 64$ lb., $m = 2.125$ ft., $a =$ half the angle of divergence of light or 5 deg. 30 min., $M_R = 7{,}220$ ft.-lb. The divergence of light is determined from the formula:

$$\tan a = \frac{\text{effective height of light source}}{\text{twice focal distance of lens}}$$

$$= \frac{36 \text{ mm.}}{375 \text{ mm.}} = 0.096$$

Angle $a = 5$ deg. 30 min.

The wind moment is determined with reference to the point where the buoy is moored. The total area exposed to the wind is 59.08 sq.ft. and the center of wind pressure is 14.55 ft. above the mooring shackle. Placing $M_W = M_R$ or 7,220 ft.-lb., the wind pressure figures 8.4 lb. per square foot, equivalent to a wind velocity of 50 m.p.h. When the wind exceeds 50 m.p.h. every flash is no longer visible from the horizon.

Observations were made at Cape Henry over a period of 4 months to ascertain the time period of the waves and the maximum recorded was 8½ sec. and the minimum was 5½ sec. Ignoring resistance, the greatest heeling angle of the buoy due to wave motion may be expressed by:

$$C = \frac{bT^2}{T^2 - t^2}$$

in which b is the maximum slope of the water surface, T is the period of the wave, t is the time period of a double oscillation of the buoy. If t is greater than T the buoy deviates but slightly from the perpendicular and inclines towards the crest as the buoy rides the wave. If T and t are equal, synchronization results and the heavy rolling of the buoy may be experienced. If t is less than T the buoy will assume the period of the wave and incline towards the trough. A buoy having this characteristic is not a satisfactory lighted buoy in open sea.

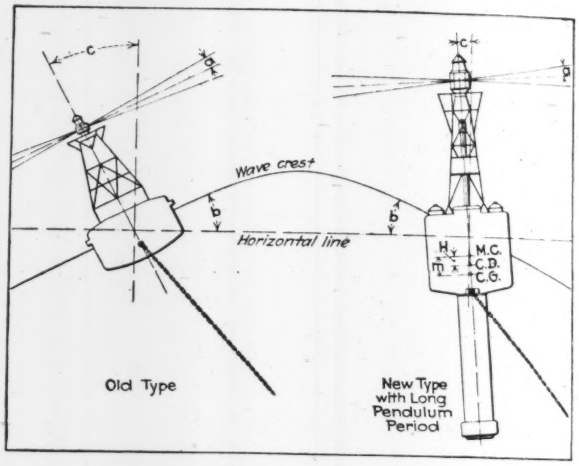


FIG. 3—COMPARATIVE STABILITY OF BUOYS OF LONG AND SHORT PENDULUM PERIODS

The time period of the buoy is determined from the pendulum formula:

$$t = 2\pi\sqrt{\frac{r^2}{mg}}$$

in which r is the radius of gyration of the weight of the buoy and m is the metacentric height. Hence it is evident that by increasing the moment of inertia of the buoy or decreasing the metacentric height increases the time period of the buoy. By modifying the counterweight and the height of the superstructure the relation of the moment of inertia and metacentric height can be varied to give the minimum required rigidity and a pendulum period that will be greater than the sea wave period. Channel buoys in sheltered waters differ in characteristic from sea buoys.

The Tail-of-the-Horseshoe Gas and Bell Buoy T.H. was established Nov. 1, 1922. The cost of the buoy was as follows:

Buoy Body	$2,700
Lantern	800
Lens	285
Acetylene Accumulator	1,100
Fog Bell Equipment	2,615
Total	$7,500

The buoy was designed by the technical staff of the Fifth Lighthouse District, Baltimore, Md.

Pile Casting Methods for Concrete Pier at Havana

Plan and Equipment of Casting Yards—Form Construction and Molding Processes—Fabricating Reinforcement—Repairing Casting Defects and Fractures

By John S. Vedoe
Inspector, Pile Casting Yard, Havana, Cuba

Over 2,000 precast concrete piles were employed in constructing the new pier in Havana Harbor, Cuba, as described in *Engineering News-Record*, July 10, 1924, p. 52, and in adding aprons to two similar piers built some ten years ago. These piles, ranging from 60 to 85 ft. long, were cast on shore, carried about one mile on barges to the pier site and there lifted and driven by floating piledrivers. The view, Fig. 1, indicates the pile arrangement in the structure.

In so large an operation there came up many problems of forms and reinforcement, handling the cast piles, and occurrence and remedy of defects, which are deserving of record since their solution by the Raymond Concrete Pile Co., as contractor, was in the hands of men long experienced in concrete pile construction. The writer as inspector kept complete notes which are the basis of this article. Intentionally the article is an account of details for the man whose task it may be to cast, cure, load and transport reinforced-concrete piles, and who has to repair defects in their manufacture and provide against the injuries which may come from curing and handling. The broader engineering problems of design and utilization have been covered in many previous articles and in the engineering manuals.

Preceding the details, it should be observed that the mild climate simplifies all concrete construction in Cuba. At Havana materials are plentiful. There are local limestone quarries producing crushed stone and local cement plants producing an excellent quality of cement. Clean coral rock sand can be had in quantities but it is not sufficiently sharp to make good concrete and must be mixed with equal parts of crushed limestone grits. This combination makes a very good aggregate. In the pile casting, a 1:2:4 mixture was used.

Casting Yard Arrangement—The contractors secured ground for their operations about a mile from the pier site across the harbor. It had railroad connection, deep water, a concrete wharf, was fairly level for about 600 ft. and had sufficient width. The area had been reclaimed from the sea about a year or two before, the fill consisting of muck pumped from the bottom of the harbor with here and there a small proportion of stone and solid material brought in carts. A hard crust had formed on top which felt firm under foot but proved not to have the bearing quality it was thought to have, and it commenced to give trouble as soon as the storage of piles was commenced.

A rectangular casting platform, about 86x115 ft., with a capacity of 120 individual forms, was erected 18 in. above ground on posts of 2x3-in. timbers, spaced about 18 in. both ways. Alternate rows were driven into the ground and the intermediate rows rested on plank laid on the—in this part—quite wet soil. The platform stood up well with very slight settlements, easily remedied. The arrangement of the component parts of the yard will be seen from Fig. 2.

Forms and Molding—The 60- and 65-ft. piles were 18x18 in., and the 70-, 75-, 80- and 85-ft. piles were 20x20 in. The floor of the forms was of 1-in. dressed pine and the sides were either 1- or 1½-in. plain-edged, dressed plank. With the exception of such parts as were removed entirely after each cast—like the top-boards, the pieces forming the sides of the tips, the butts, and the binding boards—the lumber was not renewed. Some of the forms were used as many as 17 times and would have stood much longer without replacing the principal parts. The forms were constructed so as to make sheeting and stripping extremely simple and very rapid. The labor used in these two operations was very little. The forms intended for the smaller piles were built so as to be quickly convertible into forms for the larger ones.

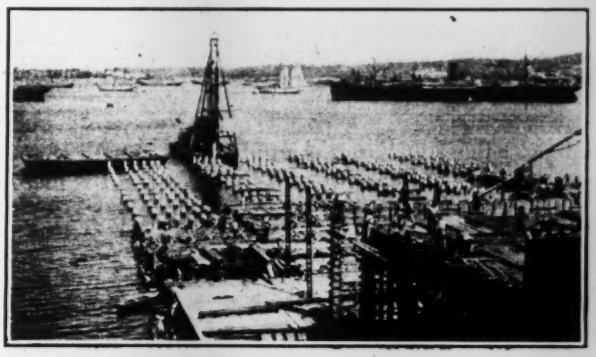


FIG. 1—PILE ARRANGEMENT AND DRIVING OPERATION FOR HAVANA PIER

Stringers of 2x3-in. sticks joined the 2x3-in. foundation posts, and on top of these were nailed 1½x3-in. strips correctly spaced to separate forms for piles of 20x20-in. cross-section. By driving wedges between these strips and the sides of the forms and by reducing the floor widths, the conversion into forms of 18x18-in. cross-section was accomplished. The sides of the forms were not cut down, a beveled strip forming the chamfer being nailed 18 in. from the floor.

The various form groups were at first arranged without regard to the center line of the platform; for instance, the 70-ft. group extended to one side 40 ft. and to the other side 30 ft. It was found better for handling to rearrange all groups so that the center line of the casting platform, the middle of all forms and the center of the clear span of the gantry crane all lay in the same vertical plane.

The binding board and top boards were removed after 48 hours while the sides were just pried loose and left in place for the next cast. This was also true of three of the four parts forming the tip, the upper part only being removed. The bevel strips in the bottom of forms and those forming the upper chamfers of the 18x18-in. piles were left in place. Ten carpenters and four laborers under a foreman were kept busy re-erecting forms.

The average number of piles cast per day was 18

and the arrangement of the 120 forms was such that casting could go on continuously. The greatest number cast on any one day was 30, while the largest amount of concrete placed in the forms was 213 cu.yd. (in twenty-five 80-ft. piles) in 12 hours. A ¾-cu.yd. mixer was employed. The general layout sketch (Fig. 2) and Fig. 3 show the location of the mixer with its material service in relation to the casting platform. The concreting gang on a busy day was 20 men, as follows: 2 men puddling, 5 on the buggies, 1 at the bin filling the buggies, 1 running the mixer, 2 at the batch hopper, 2 bringing cement from a storage to the Decauville incline (the mixer engine pulled the cars up the incline to the mixer platform by cable), 1 on top of the aggregate storage bins, 2 in the material cars guiding the ½-yd. clamshell, 1 fireman, 1 derrick engineer and 1 floater, all under the concrete foreman. One man easily transported 4 or 5 cu.ft. in the balanced, underslung buggies, with wheels of large diameter; these were very satisfactory and far superior to wheelbarrows.

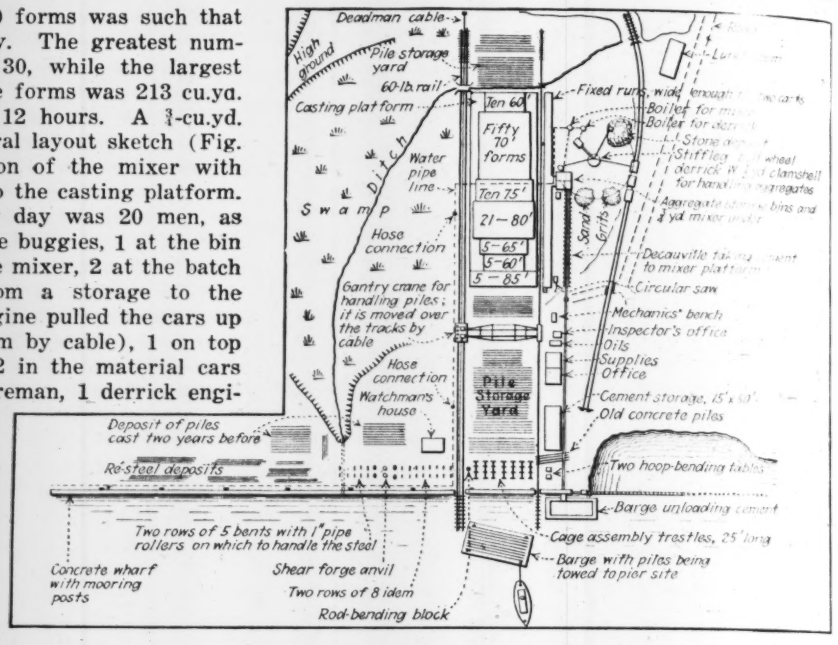


FIG. 2—PLAN OF PILE CASTING YARD AND EQUIPMENT

The forms were oiled every two or three casts. Large eyebolts were used to pick up the piles, and in casting, taper maple plugs were placed in the forms at the handling points, and were turned about a half hour after casting and again several times during the first two hours of set, when they were entirely removed and a wad of paper or sacking was put in the hole to keep out débris. At the upper end was a crosswise ¾-in. hole for turning. Those that were not turned in time had to be drilled and burned out with hot steel rods, quite a laborious operation.

After the forms were stripped the length and date was painted conspicuously on the end of the butt of each pile and they were wetted daily several times as long as they lay in the forms (from 5 to 8 days), after which they were lifted and placed in storage until approximately 30 days old. They were usually driven at the age of 30 days; a few were driven at 25 days.

Fabricating and Handling Reinforcement—The "cage" of an 80-ft. pile is shown by Fig. 4. The rods at the handling points were changed two or three times. The design of the butt ends was of two types. The one shown in the sketch, where the main rods run straight to within 3 in. of the concrete surface, proved the most successful in hard driving with less shattering of the concrete. In the other type the main rods were bent at right angles a foot from the end, the ends being wired together in the shape of a cross. The bonnet casting fitted over two recesses or shoulders at the butt; a native hardwood, set endwise, was used as cushion in driving.

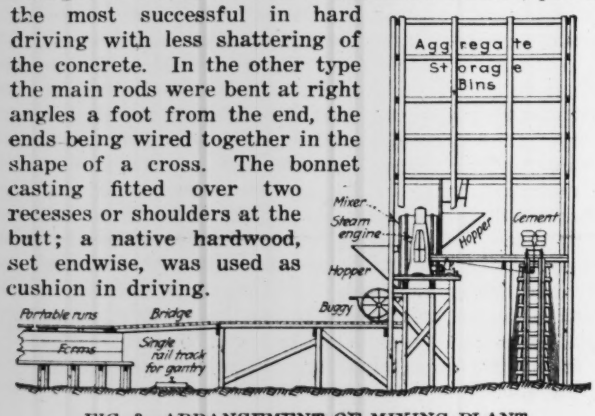


FIG. 3—ARRANGEMENT OF MIXING PLANT

The rods were blacksmith welded; two day gangs and at times two night gangs, each composed of 6 men including the welder and his assistant, were employed. Each gang was provided with a forge, anvil, shear and accessories. The rods were placed on wooden bents the height of the forge, with 1-in. iron pipe rollers on top. Pulled to the forge, a rod on each side, they were welded. Then they were moved along in the same direction clear of the forge, passing through—or close to—the shear jaws up against a stop, and cut off to correct length. Again pulled forward a few feet by two men to the bending block they were given the proper bend for the tip of the pile. Passing through the heavy studs of this block any kinks in the rods were taken out and at the other extreme the bend (if any) for the butt of the pile was made. They were now resting across the assembly trestles, Fig. 5, pulled clear of the bending block, and were in position to become parts of a cage. One man, sometimes two, was constantly employed in bending hoops, and another in cutting rods to the correct length. It was necessary to make hoops that were perfectly square, for if this was not done, the cage would become slightly lop-sided and consequently difficult to center in the forms. Eight or ten men usually worked at the assembling of cages. This gang turned out on an average 20 a day and was usually through at 4 p.m., when the men were allowed to go home as an inducement to rapid work. They were paid 35c. an hour. The assembly work was sublet.

It is important that the main rods be perfectly straight as otherwise they cannot be made to lie close in the bends of the hooping; they will throw the cage out of true, and they are apt to twist so that the bends at the extremities will not take their intended positions and will jam in the forms. The twisting was finally avoided by tying the ends of the rods firmly into position with wire, Fig. 5, bent to keep within the concrete.

Due to the bent condition of the steel when it

arrived, a straightening gang was at work almost constantly. This expense can be avoided by demanding proper care in handling by the transportation companies. In Havana harbor the steel was hoisted from the steamers into barges, and it was especially in this transfer that much of it became bent. The heavier bars (⅞- to 1¼-in.) which were not tied in bundles suffered most.

The assembling was done upon seven trestles, Fig. 2, about 25 ft. long, 3½ ft. from the ground and spaced 12 ft. apart. Each had a strip of ¼x1-in. flat iron fastened along the top with countersunk screws. Provision was made on top of the trestles for two gangs to work at a time. When five cages had been completed they had to be removed by the crane to make room for more and they then went either directly into

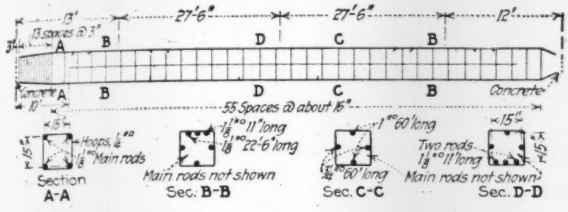


FIG. 4—REINFORCING "CAGE" FOR AN 80-FT. PILE

the forms or were stored on top of the piles in the yard until wanted.

When taken to the forms the cages should be well centered in the gantry so that they can be lowered without having to be dragged along over the edge of the forms by hand thus bending and disturbing the reinforcement. An 85-ft. cage weighed 1,830 lb.; so it is easy to imagine the results when it is dragged along by hand. Should it become necessary to adjust a cage by hand, it should be taken by the main rods and not by the hooping, which is where the men will grab it if they are not watched. Small precast blocks of concrete, Fig. 5, held the cage centered in the form.

Pile Lifting and Handling—Recessed in the bottom of the forms, at the handling points, were 6x6x1-in. plates tapped for 1½-in. bolts. The eyebolts were inserted in the holes formed by the taper maple plugs and screwed into the plates. On the lower flange of the heavy I-beam, which was lowered and raised between the bridge trusses of the gantry by a cable at each end, slid the handling hooks, adjustable horizontally as well as vertically by hand. The gantry was brought into position over the pile, the beam lowered and the two hooks—sometimes three were used—were slipped into the eyebolts.

The crane crew has the fate of the piles in its hands. The eyebolts must be screwed into the plates a safe number of turns; the threads of both examined frequently for wear and they must be discarded in time to avoid stripping; the blocking upon which the piles are to rest in the yard and on the barges must be placed with care; the handling hooks of the gantry must be adjusted nicely vertically to take the weight of the pile simultaneously; the crane engineer must apply his brakes gradually when lowering a pile, for if they are applied suddenly the free portions of the pile outside and between the supports will be given a violent up-and-down rebounding motion.

Care was taken to prevent any cracks occurring in the piles, but a few piles cracked in spite of all precaution. It is the writer's opinion that these could have been prevented by improvements in the handling devices. A device whereby the hooks would automatically adjust themselves to take the weight of the pile simultaneously would be desirable. Shocks and jars imparted to the pile in passing over the tracks should be carefully avoided. Rails without flaws in the heads are not sufficient; the joints should be close together and perfectly level; they might even be welded to secure a smooth track. It is well known that the fine cracks will appear in concrete beams at very slight loads and that such cracks are not considered by many authorities as serious or even important. Piles, however, are to stay submerged in water and it is consequently highly desirable to preserve the concrete covering over the rods free from flaws and cracks.

Defects and Cracks—When casting the piles, porous surface cracks or indentations appeared in some cases in the upper surface of the piles. This was thought to be due largely to unequal setting in the hot sun, and the piles were covered with burlap stretched upon frames, and wetted. It cannot be said that the trouble entirely ceased after this procedure.

In some of the piles, there appeared fine transverse cracks such as will sometimes develop in reinforced-concrete beams under light loads. They made their appearance after the piles had lain in storage one or more days, and never while in the forms. In a few of these cases the causes were directly traceable to stresses imparted due to the settling of the timbers upon which they lay.

Repairing Injured Piles—The cracked piles were all

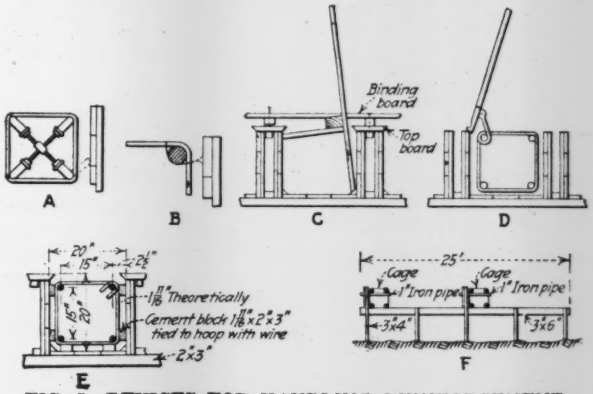


FIG. 5—DEVICES FOR HANDLING REINFORCEMENT AND FORMS

A—ties holding bent bars at tip of pile. B—wire tie fastening bar to hoop. C—tool for lining up forms. D—tool for shifting cage in form. E—cast cement blocks to keep cage centered in form. F—trestle for assembling cages.

either repaired by casting a scab around the injured portion or put in condition by waterproofing the cracks.

In the latter instance the cracks were first chiseled out V-shaped to a depth of ½ or ¾ in. The surface was then carefully heated by a torch and a preparation of about 90 per cent pitch and 10 per cent coal tar, boiled and well stirred together, was poured hot onto the V-shaped cut.

The piles which were repaired by casting a scab around the injured part were prepared by cutting away the concrete to a depth of ¼ in. all around, the piles being turned over during this operation. Six or seven ¼-in. reinforcing rods were placed longitudinally on

each side, to which was fastened the hooping of the same section. Where the cracks were open and prominent, the concrete was cut away to below the steel. The form was built 4 in. from the sides all around and extended about a foot on either side of the injured section. The pile thus became 28x28 in.; this still gave sufficient clearance in the leads. The piles so repaired, when handled by the crane after a few weeks, hung stiff and rigid in the hooks. They were distributed in the pier—or apron—foundations far apart from each other and behaved well in driving.

Three barges were used in transporting the piles to the site. They were about 30x70 ft. Timbers were laid crosswise on deck, spaced about 10 ft., carefully leveled and spiked. The superintending of the loading was usually done by the chief carpenter himself. These piles were carefully watched when lowered onto the timbers and shims were placed where necessary. They were loaded two high, the top ones always resting on supports at handling points as when stored in the yard.

The general contract was held by the Parklap Construction Co. of New York. Charles E. Lund was the local manager and chief engineer and under him George Perrine was resident engineer. The casting and driving of the piles was entrusted to the Raymond Concrete Pile Co. of New York. The Turner Construction Co. of New York built the superstructure. Both of these firms shipped their plants from the States.

Electric Locomotives of Unusual Design Ordered by Two Railroads

SEVEN locomotives of a somewhat unusual design have been ordered by the New York, New Haven & Hartford R. R. Co., to be built jointly by the General Electric Co. and the American Locomotive Co. Five of them are for main-line freight service and two for switching service. This new type of electric locomotive, although actuated from a single-phase trolley, does not have alternating-current traction motors. Each locomotive, instead, will contain a traveling substation and will be equipped with a synchronous motor-generator set for converting the 11,000-volt, 25-cycle, single-phase supply to direct current for the traction motors.

Power is collected by the usual slider pantograph trolley and is delivered to a main transformer situated in the locomotive cab. This transformer steps down the trolley potential to 2,300 volts, which drives a single-phase synchronous motor direct-connected to the main generator. The main generator which delivers current to the traction motors is designed with a variable field and the speed of the locomotive is regulated by field control of this generator. This system of control, by varying the field strength of the generator used, in connection with the characteristics of the motor generator set, gives a locomotive which is extremely flexible and adaptable to all operating conditions. The traction motors are of the standard series, direct-current railway type.

In double heading, the locomotives will function in multiple units with the present single-phase locomotives.

Locomotives of a somewhat similar type are being built jointly by the Ford Motor Co. and the Westinghouse Electric & Manufacturing Co. for use on the Detroit, Toledo & Ironton R.R. The trolley voltage to be used on the D., T. & I. is 22,000 volts, 25 cycles, alternating-current, twice that used on the New Haven.

Irrigation and Drainage Laws Critically Reviewed

Department of Agriculture Reports on Land Reclamation Policies—Subsidies and Failure—Too Much Irrigation Development

A COMPREHENSIVE review of national and state legislation on land reclamation has just been published by the U. S. Department of Agriculture as Bulletin 1257, written by R. P. Teele, agricultural economist. A brief summary of the bulletin is given here because of the direct bearing of legislative policies and their practical working upon engineering enterprise in the fields of irrigation, drainage and timberland reclamation.

Figures compiled in 1921 indicate that the total of reclaimable land in the United States is about 120,000,000 acres. Much of this land now produces something, in grazing or timber, or serves usefully as shelter for game, but such productive value is exceedingly slight.

Federal Laws—Federal action on waste lands began in 1849, by the granting of public *swamp lands* to the states; 64,000,000 acres have been thus granted. Other public lands were first put under their modern rule of development by the passage of the *Homestead Act* in 1862, which enabled title to be obtained by residence on the land instead of by purchase. In 1866 an act was passed which in effect recognized state and local rights and customs concerning the appropriation of water and its application to land, and this is still the basic act controlling the relative rights of the states and of the federal government in matters of water.

Development of *desert lands* was brought under the scope of legislation in 1877 by an act providing that title to 640 acres could be secured by irrigating it and meeting certain other conditions, the area being reduced in 1890 to 320 acres. Under this act something like 8,000,000 acres have passed into private ownership, though there are unsettled claims to a very much larger acreage.

In 1888 provision was made for government surveys to determine what arid lands could be reclaimed by irrigation. In 1894 the *Carey Act* was passed granting to the states certain *arid lands* within their borders on condition that the states provide for their reclamation; under this act segregations have been made to the extent of about 1,500,000 acres, two-thirds of which is already patented. Eight years later the *Reclamation Act* was passed, which represents a basic change of federal policy from that of facilitating local reclamation to direct federal-loan reclamation. By its subsidy feature, which resides in the elimination of interest charge for a long period of years, this act has a tendency "to discourage development under other acts, by offering more favorable terms." However, the very reason for the passage of the act was that "reclamation by irrigation in the United States had always been a failure" from the standpoint of the investor. This was true alike of corporate enterprises, state district enterprises, and Carey Act enterprises, so that it had become almost impossible to obtain funds for reclamation work.

Under this act about $172,000,000 have been spent and $41,000,000 returned; 1,250,000 acres have been placed under irrigation and 1,175,000 acres have been

put in crops. With interest at 4 per cent, this work has cost the government more than $200,000,000. The act was amended in 1914 to make the time of repayment twenty years instead of ten, and in 1920 to increase the reclamation fund by income from oil leases and from water power, but the interest-free feature has never been changed. On the contrary, on many federal reclamation projects the beginning of capital repayment was so long postponed that the subsidy to the farmer was multiplied three or four times. The longest postponement was 14 years. If the interest lost on deferred payments is figured at 6 per cent, the farmer who begins his payments immediately on completion of the irrigation works will still owe 136 per cent of the cost at the time when he completes his payments, while the farmer whose payments are postponed for fourteen years will at the end of his payments still owe 517 per cent of the cost of the work.

The last federal irrigation act was passed in 1916, permitting public lands within the boundaries of state irrigation districts to be taxed like other lands in the district. This reverts to the original policy of federal land legislation, to facilitate local reclamation rather than to extend the scope of federal reclamation.

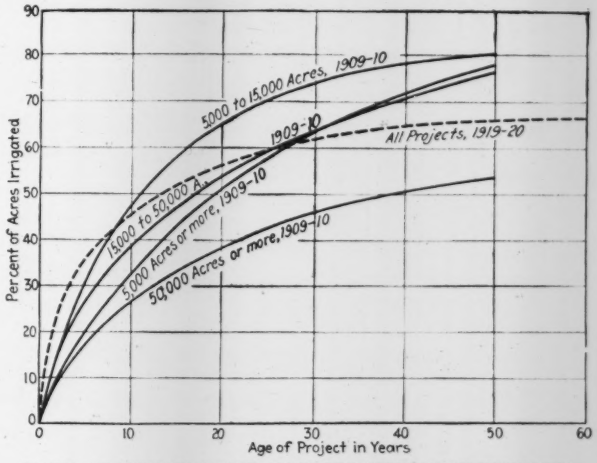
State Irrigation Laws—Irrigation district laws in the states began in 1865 (Utah), but the first effective law was passed by California in 1887, other states following soon after. The financial unsoundness of irrigation districts as developed by experience later led to requiring state investigation of an irrigation project as a prerequisite to formation of a district. Later, state certification was devised as a method for increasing the sale of district bonds; by such certification, after investigation, district bonds are made legal investments for trust funds and public funds. Beginning in 1913, certification laws were passed in California, Arizona, Colorado, Idaho, Wyoming, Montana, Nevada, Oregon, and Utah; the Utah law, however, was soon repealed, the Wyoming law was declared unconstitutional, and the Colorado law has not been made use of. Certification is said to have been quite successful in California, there having been only few defaults in interest payments on certified bonds.

Oregon carries certification farther, by guaranteeing and in fact paying the interest on district bonds for one to five years; in the actual application of this law the state officers have made supervision of expenditure of the funds a condition of approval of the bonds. None of the state-aid districts has yet reached the stage where it must pay its own interest, so that the value of the law has not yet been tested. Washington has gone still farther than Oregon, by providing a fund of $5,000,000 for the purchase of district bonds, but operations under this law have not been extensive enough to show its possibilities.

On certification, guarantee and supervision of irrigation district securities, the report says:

> Each advanced step in public supervision has, for a time, been effective in promoting the sale of bonds. The latest laws, providing for state certification of bonds as legal investments for trust funds, etc., seem to go as far as it is possible to go in public supervision that involves no public liability. These laws contain ample authority for investigation, and the practice in the various states seems to be to include all reasonable safeguards. The fact remains, however, that some certified bonds are in default and there is a widespread belief that others soon will be. Even if it proves that the security behind the bonds is sufficient to prevent loss on the part of bond holders, it will take but a few defaults to render the scheme ineffective, since bond buyers do not care for investments that necessitate foreclosure. In certifying bonds the states assume no legal liability, although there may be some moral obligation if public and trust funds, or even private funds, are lost through default on bonds on which the state has put its stamp of approval. On the other hand, when the states have put their funds into paying interest or buying bonds or constructing works, there is a distinct possibility of financial loss.

Many districts have failed. A summary of irrigation districts organized under state laws show that out of 598 districts in all, 244 are operating and 158 have gone out of business, while 196 are still in preliminary stages. Rather more than half of these districts were organized for the purpose of taking over projects developed by other agencies. Counting only those districts that have passed beyond the preliminary



RATE AT WHICH LAND IN IRRIGATION ENTERPRISES HAS BEEN PUT UNDER CULTIVATION
Based on returns of 13th and 14th censuses

stages, of a total of 402, 158 have gone out of business, or about 40 per cent. Of those which were organized to promote new projects, 70 per cent have gone out of business, while of those organized to take over old projects only 20 per cent have gone out of business. "On the basis of these figures the chances for failure on the part of districts organized to develop new projects are more than two to one."

State Land Settlement—The California state land settlement enterprise, started in 1917, is a distinct type of reclamation policy. The Land Settlement Board acting under this law received a large direct appropriation from the state and with it developed the Durham and Delhi colonies [under a system fully described by George C. Kreutzer in *Engineering News-Record*, Nov. 22, 1923, p. 838]. The Durham colony was rapidly settled up and the 139 settler families appear to have made a good success. The Delhi project "encountered conditions exactly opposite to those at Durham. The reclamation work was done at peak prices, while the land came on the market during the depression in agriculture. Notwithstanding these conditions, the rate of settlement has been much more rapid than is customary," but the colony is less than three-fourths settled at present. "If it develops that the state settlement projects are a financial success, and that settlers can succeed on the prepared farms purchased on easy terms, when they cannot under other conditions, these experiments may show the way for private enterprise."

Federal and District Co-operation—A brief discussion is given of federal reclamation to be repaid by bonds of state irrigation district organized to develop the land. The author does not look favorably on the plan, saying "There is nothing in the history of either the Reclamation Service or the irrigation districts to indicate that the reclaimed lands will be put into use promptly, or that settlers will be able to meet their payments promptly when they get on the land."

Drainage Reclamation—Because of the granting of swamp lands to the states by the federal government, the latter has no drainage reclamation policy expressed in legislation. States have developed extensive sets of laws on the subject, however. Two principal types of organization of drainage work have resulted, the corporate district and county drainage, the latter being handled by county officials like any other local improvement. Practically all drainage represents assessment of benefits against the land improved. In some parts of the country most of the drainage work affects land previously occupied and partly farmed, while in other parts, principally the South Atlantic States, drainage reclamation deals largely with vacant land and therefore involves the problem of land settlement. "A very small part of the land is producing the means of meeting the cost of reclamation."

Drainage enterprises comprise a total of 69,000,000 acres, of which 46,000,000 are improved land, 12,500,000 timber and cutover land, and 11,000,000 other unimproved land.

A similar summary of irrigation enterprises as they stood in 1920 shows a total acreage included of 36,000,000 acres, of which 26,000,000 acres were capable of irrigation and 19,000,000 acres actually irrigated.

Excess Reclamation—As the total area of irrigation projects exceeds the actually irrigated area by about 17,000,000 acres, there is a large margin for settlement and farm development before additional irrigation works should be necessary. The corresponding undeveloped land in the field of drainage is 24,000,000 acres.

Taking as a measure of irrigation growth the figure of 4,700,000 acres, increase in irrigated area in the United States in ten years (1909-1919), the excess area of irrigation projects can take care of the probable growth for 35 years. Thus, irrigation development has gone on far ahead of the need for it; "investments are made many years before the works built are put to use, and during that period are unproductive, and interest and upkeep pile up to such an extent as to cripple the investors, unless they are government agencies with the public to absorb the losses. . . . It is believed that the tendency to overdevelop or rather to develop too long in advance of the effective demand for the land is the principal cause of the almost universal financial failure of recent reclamation work. This tendency arises from the natural desire of every community to have its waste lands developed, and from the prevailing system of financing the work. The benefits, without the burdens, accrue to the community; and the losses, in case of failure, fall on the outside investors."

The over-development is shown graphically by curves plotted from census figures which show the percentage of irrigated area on irrigation projects of different ages [reproduced in the cut, p. 789. The 1910 curves were shown in *Engineering News* of August 3, 1916]. "The curves show plainly the immediate cause for the financial failure of irrigation enterprises—the very low rate at which the land included is brought into production. The real problem in reclamation work is bringing the land into use promptly enough to prevent financial failure caused by heavy carrying costs chargeable to land that is not producing. Private enterprises operating under various state and federal laws have attempted to solve the problem by extensive advertising and high-pressure sales methods generally, but these have failed because they aggravate the trouble by increasing the cost, and because they do not touch the larger part of the problem, which relates to the development of the farms. They merely bring about sales. The state of California has attacked the problem from another angle. It does not attempt to lighten the burden, nor to shift it, but rather to put the land and the farmer in position to carry it. The very brief California experience seems to indicate that providing capital for farm development aids very greatly in bringing the land into use promptly, but that this will not be effective if reclamation works are over-built to any considerable extent."

The Future of Reclamation—For the immediate future, says the author, there is no national need for reclaiming more land, on account of the agricultural overdevelopment that resulted from the war demand. However, he discusses the policy that should be adopted for further government reclamation, particularly the need for or wisdom of a subsidy.

No subsidy is held to be justified today for the purpose of producing a local agricultural supply: In the early years of reclamation the farmers used a cheap water supply to produce for a high-priced local market; in recent years they use a high-priced water supply to produce for distant markets, where they must compete with supplies grown without irrigation." Nor is a national subsidy justified by the creation of taxable values: "If a subsidy is granted on these grounds, it seems evident that those who reap the benefits should pay the subsidy. The political subdivisions that levy on the taxable values created should pay the subsidy." Specifically, the author presents these conclusions:

There is no justification for a national subsidy to land reclamation. If local interests justify the subsidizing of land reclamation, the subsidy should be local.

If it becomes desirable for the nation to subsidize agricultural production the subsidy should apply to agricultural production generally, not to one type of expansion alone.

Land reclamation is a form of agricultural improvement, and any reasons that justify public aid in financing other agricultural operations apply to land reclamation. Such aid should be conditioned upon the same degree of security for repayment of advances that is required in other fields.

If public aid is employed in financing reclamation there must be a high degree of public supervision of construction and operation during the development period, or actual public construction and operation.

Public financing makes possible public control of the selection of land to be reclaimed and of the rate of reclamation, but there goes with this the possibility of both the rate and the location being controlled by political rather than economic considerations.

There should be sufficient public supervision of private enterprise to prevent misrepresentation or fraud in the sale of both securities and lands.

The chances of financial success of both public and private enterprises will be improved by making preparation of land for immediate use a part of reclamation work and by providing capital for improvements and equipment. All these involve a high degree of supervision of agricultural operations until repayment of advances has progressed sufficiently to make the security for the balance ample.

Winter Reconstruction at the Spier Falls Power Plant

Old Foundations Adapted to Suit Larger Units—Unwatering Part of the Tailrace a Difficult Problem—Methods and Results of Winter Concreting

By C. Voetsch
Hydraulic and Electrical Engineer, Utica, N. Y.

INCREASING demand for power and the desirability of adapting all power plants in the northeastern states to 60 cycles to suit the proposed superpower systems have necessitated the reconstruction of part of the old hydro-electric power plant on the Hudson River at Spier Falls, N. Y. Reconstruction of the remainder is to be carried on in successive steps as occasion demands. The first step, that of installing one new unit, is the one dealt with in this article.

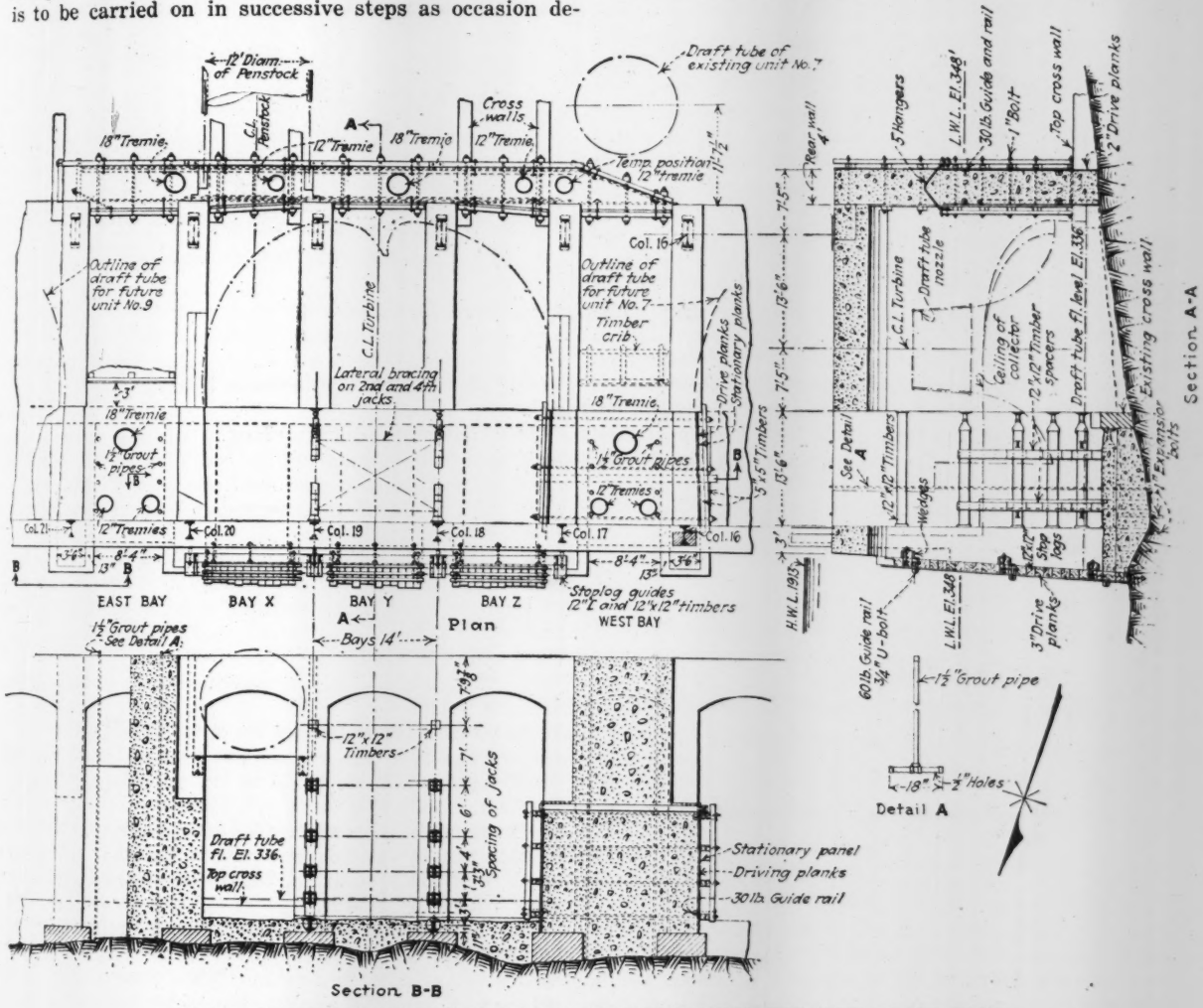


FIG. 1—ALTERATIONS TO POWER HOUSE FOUNDATIONS FOR NEW DRAFT TUBE
Showing position of tremies for concreting under water.

The Spier Falls plant is one of the older hydro-electric plants on the Hudson Rver and although it has a good record for past performance, improvements in design since it was built make the installation of new and larger units more advisable than the reconstruction of the old-type machines. Moreover, the floor of the existing power house is too low and needs to be elevated in order to be above the level of high water during floods. Under the proposed arrangement, one new 60-cycle unit will replace two of the older units in the case of probably all but three of the seven. These three are to be rewound to 60 cycles.

The power house was built for ten units of the old type; seven were installed and the remaining space is sufficient for two new units without dismantling any of the old ones. The reconstructed plant will therefore have an ultimate installation of four units of 9,000 hp. each and three units of a combined horsepower of 15,000, or a total of about 51,000 hp. The head of the plant is 80 ft. and may ultimately be increased to 87 ft. Regulation of the Hudson River is expected to improve the flow conditions before the enlargement of the plant is completed.

The power house is 392 ft. long, divided into 28 bays

14 ft. wide. Its walls on the river side are supported on a concrete wall with arched openings under each bay. The main floor is supported on concrete arches between long piers in each bay and by slabs between these arches and the outer wall. The details of this arrangement and of the setting of the old turbines and generators are shown in Fig. 1 and Fig. 2. It will be seen from Fig. 2 that the whole area under the power house is open and that in order to unwater any portion of it that portion has to be entirely surrounded by a cofferdam or temporary wall of some sort.

The new unit occupies the three bays between columns 17 and 20 and the new draft tube was designed to occupy the space between the piers supporting the corresponding arches under the generator floor. The layout is shown in Fig. 1. The fact that generator No. 7 was in the bay between columns 16 and 17, and that part of the discharge from this turbine would have to pass along under the back part of the bays between columns 17 and 20 complicated the problem of unwatering the space for the new draft tube. However, in other respects the layout of the old foundation lent itself to this work, its only drawback being that the concrete of which it was built was poor and full of cracks due to lack of expansion joints and reinforcement, and to poorly bonded construction joints.

Fig. 1 shows the way the space for the draft tube was inclosed. The crib under generator 7 was built up in short sections in the space between the water surface and the arch and sunk by filling it with stones.

Before the forms were built and after the floor between the generator arches had been removed, the débris, lying about 8 ft. deep on the bottom of the tailrace, was removed in part by means of a single-line clamshell operated by the overhead crane in the power

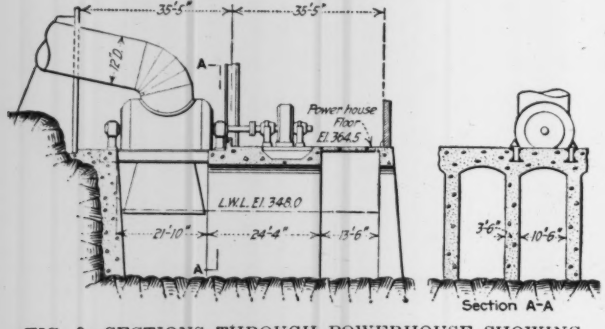


FIG. 2—SECTIONS THROUGH POWERHOUSE SHOWING POSITION OF OLD UNIT

house. The part that could not be reached by the crane was sluiced out into the open tailrace by means of a 1¼-in. stream delivered at a pressure of about 60 lb. This sluicing process proved to be very efficient, considering that it had to be done under 25 ft. of water. It resulted in a clean rock surface.

When this was completed stop-log guides were first bolted to the downstream face of the pilasters by a diver and then stop logs and the drive-sheeting placed. The latter had to be applied in this way because the stop logs could not be lowered within from 3 to 4 ft. of the uneven rock surface. Anchor bolts 1 in. in diameter were drilled into the rock to hold the bottom slab against upward pressure.

The 4-ft. rear wall, reaching from column 16 to column 21, formed the back of the draft-tube structure and the support for the chamber containing the auxiliaries to the generator and the switchboard floors. Formwork for it was complicated by cross walls on the bottom and by the fact that the forms had to fit in between the arches of the main generator room floor. The forms were assembled on the power house floor,

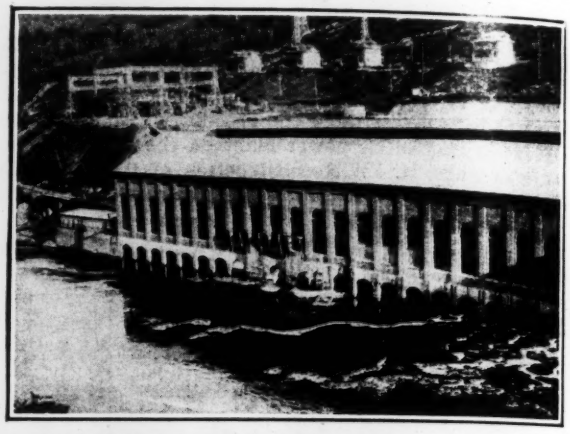


FIG. 3—EXTERIOR OF SPIER FALLS POWER HOUSE

picked up in sections and supported over the openings while the reinforcing was placed and then lowered until they rested on the cross walls. The lower part was closed off with sheetpiling and finally sealed up by a diver.

The pilasters and arches supporting the power house wall had to be backed up by jacks on account of the pressure against the stop logs and also on account of the cracks in the arches and poorly bonded construction joints.

When all the forms were completed and had been made as watertight as possible by the diver, the concreting began. Three tremies were used, two 12 in. and one 18 in. in diameter, operated by chain falls. On account of the limited space between the water surface and the hoist, the tremies had to be made in 3-ft. sections. As soon as a 3-ft. section was completely out of water the concrete was lowered close to the water surface and then the section was removed and the hopper replaced. The location of the tremies is shown in Fig. 1. About 250 cu.yd. of concrete were placed in one continuous operation for each block, raising the surface above water level at about El. 353. The rest, up to the floor level at El. 364.5, was ordinary concrete work placed by chutes.

The aggregates were heated in the mixer by two kerosene oil torches to a temperature of from 70 to 80 deg. F. as described later. When pouring the block between columns 20 and 21, the lowest temperature in the power house was 15 deg. below zero and outside 20 deg. below zero. The block between columns 16 and 17 was poured under better weather conditions, the outside temperature ranging between 20 and 27 deg. F.

The 4-ft. thick rear wall reaching from columns 16 to 21 was poured when the outside temperature ranged from 20 to 42 deg. and no torches were used, but the water was heated by steam. Four tremies were used in pouring the concrete on account of the cross walls in the bottom. Care had to be taken to fill the pockets uniformly so that concrete would not spill over the cross walls at any point and so be badly washed.

When the concreting was completed the grouting pipes which were set in place when the forms were built were blown out and a neat cement grout of a 1:1 mixture was forced down through the pipe. When the pit was unwatered the main leaks were found to be in the corners at the end of the stop logs, where they could be readily closed up. The remainder of the leakage was through rock seams and joints between the old and new concrete. The total amounted to about 1 gal. per second, considerably less than was expected from such a large surface.

FIG. 4—DRAFT TUBE PIT FOR NEW UNIT
Old concrete piers partly cut away.

After the draft tube floor had been poured the pilasters at the tailrace side of the building were reinforced by a 4x5-ft. concrete column designed as a vertical beam and poured at the same time as the collector. When the concrete had set sufficiently to take the load the jacks were burned off flush and the remaining old concrete removed. Fig. 4 shows the pit at this stage; the part outlined is the top of the collector forms. Then followed the erection of the cone, cast-iron columns and bell of the draft tube with the surrounding concrete upon which the turbine, scroll case and generator were erected.

Winter Concreting—So little has been published on the subject of concreting under water in freezing weather, it is believed that some particulars concerning the way it was carried on at Spier Falls will be of value, especially because there was an opportunity to examine the concrete as it was exposed during the progress of the work.

The stone pile was heated by a grill of 1¼-in. steam pipes 18 ft. long, spaced 18 in. apart, and sand was heated by banking it over a stove made of a short section of 5-ft. penstock terminating in a short chimney. However, so much material was handled during concreting that this method was found ineffective, sand frequently went to the mixer in frozen lumps and stone went unheated. The result was that entire dependence was placed on heating at the mixer. Water was heated by inserting a steam jet in the measuring tank. The ¾-yd. mixer was heated by two kerosene torches placed side by side with their discharge elbows in the charging opening. It revolved at 17½ r.p.m. The torches were connected to a 20-gal. supply tank and consumed about 3 gal. of kerosene per hour each. On account of drills running on the air pressure line which supplied the torches the pressure varied from 30 to 75 lb., causing considerable trouble and frequently putting out the torches. It was found that a pressure of 30 lb. gave the best results and if kept fairly constant the torches worked steadily. Due to the air pressure and to windy weather it frequently happened that the torches went out. As reaching into the mixer to reignite them was dangerous a method of lighting them was developed in which a simple gas oven igniter connected to an acetylene gas tank was kept burning at a point convenient to the mixer.

In mixing the concrete, sand, cement and water were placed in the mixer first and after a few revolutions of the drum the stone was added. The mixer was then run from 1½ to 2½ min. with the torches on full in order to obtain a temperature of from 70 to 80 deg., the time depending largely upon the outside temperature. One-half minute additional time given in the mixer increases the temperature by about 22 deg. In chuting it was found that a drop of 10 deg. occurred in the 50 ft. of chute between the mixer and the tremie. In pouring the west bay with the mixing water at 85 deg. and the concrete mixed for 2 min., it left the mixer with a temperature of 89 deg. and had dropped to 60 deg. by the time it reached the distributing hopper. The outside temperature was 20 deg. above zero. In this case concrete had to be transferred from chute to hopper in a bucket.

Studies of the temperature in the body of the concrete were made during the process of setting, using the grout pipes as a means of getting temperatures in the interior of each block. In the east bay the eight grouting pipes were 1 ft. from the surface of the wall, in the west bay 2 ft. 6 in., and in the rear wall 2 ft. from both outside surfaces. Although the values observed may contain errors on account of the fact that

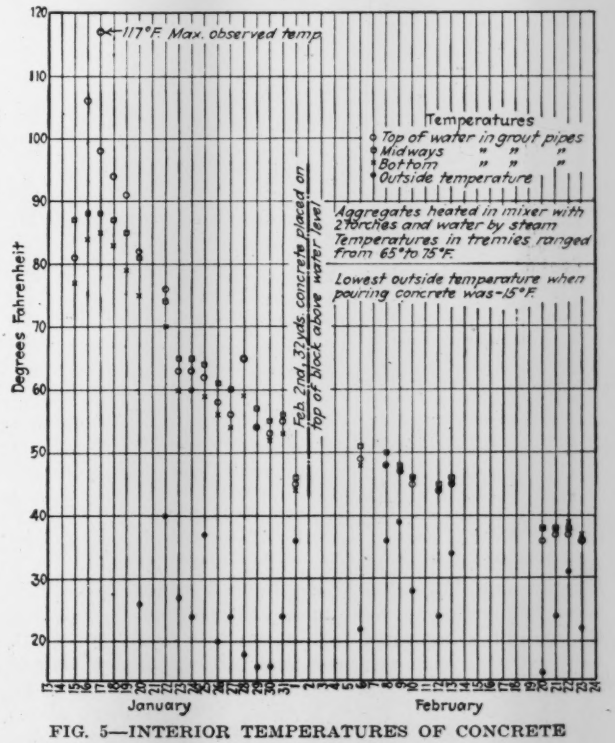


FIG. 5—INTERIOR TEMPERATURES OF CONCRETE

the iron pipes are good conductors of heat, and possible circulation of the water in the pipes, yet the temperature curves shown in Fig. 5 indicate in a general way how cooling of the concrete occurred. The marked rise in temperature of the freshly poured concrete, due to chemical action, is of interest in such winter concreting. The temperature of the water on the outside of the walls was 32 deg. The values plotted on the temperature curves are averaged for the several pipes. Much more rapid cooling occurred in the rear wall due to its shape and amount of exposed surface.

Concreting Under Water—The 18-in. diameter tremies were made of No. 10 gage steel plates with longitudinal riveted seams, and the 12-in. tremies of No. 10 spiral riveted steel plates. They were operated by a five-ton and three-ton double speed chain fall. The hoist and supports were made strong enough to carry the weight of a tremie full of concrete as it frequently happens with rich mixtures and tailings that a charge becomes lodged in the tremie. Most of the trouble occurred with the 12-in. tremies when tailings about 4x2½x1¼ in. were admitted to the 2½-in. ring stone. The smoothest work was done with the 18-in. tremies, 1½-in. ring stone, and a concrete mix of 1:2:4 to 1:2½:5. One of the tremies was provided with a foot valve with the idea of filling it with concrete and lowering it in place to start concreting. As this proved to be too cumbersome, the pouring was started by filling the tremie after it had touched the rock bot[illegible]. However, in order to allow for leaching out of [illegible]ent and to insure a good bottom layer, eight sack[illegible] cement were used on each yard of concrete at the [illegible]art, this amount being gradually reduced to 4½ sacks [illegible] the top of the block. The greatest distance that co[illegible]rete was intended to travel from the end of the tremie was 9 ft., but in a few cases it traveled as much as 15 ft. Samples brought up by the diver taken from a point 8 ft. from the tremie showed that the aggregates had not separated. Few charges were lost through accidents or inexperienced men handling the tremies and when the concrete was exposed only a few places were found where patching was necessary.

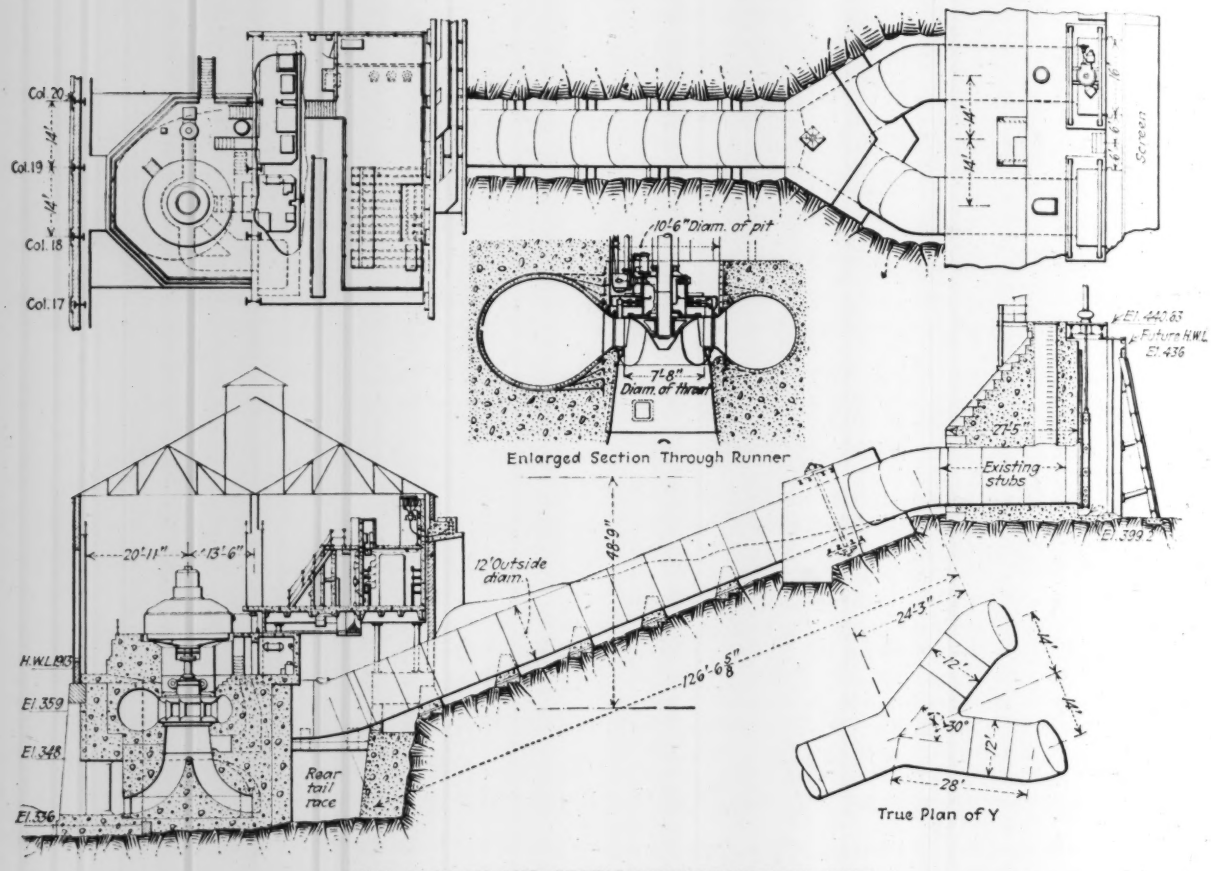


FIG. 6—PLAN AND SECTION THROUGH NEW UNIT
Showing intake stubs for two units of former layout combined for one new unit, also tailrace behind draft tube of new unit to serve old units until replaced.

The danger from inexperienced foremen trying to make short-cuts is great. If not watched, they will let the concrete run through the tremies and will not maintain the water lever inside the forms at the same level as the outside.

As to the inclination of the concrete chutes, it may be said that 19 deg. with the horizontal appeared to be the limit in a semi-circular steel chute if it was to be self-feeding. In a chute at an inclination of 15 deg., the concrete had to be helped along after the effect of the starting velocity had been overcome by the side friction.

Intake, Penstocks, and Headgates—As one new vertical unit requires about the space provided for two old

horizontal units, it was possible to use two of the existing bays at the intake structure in order to obtain a liberal size of rack and small entrance losses. The two-rack sections are 16 ft. wide and submerged about 33 ft. The bars are 4x⅝ in., round edge, and spaced 3 in. apart. This gives ample area even with a partial clogging or drawing down of the pond.

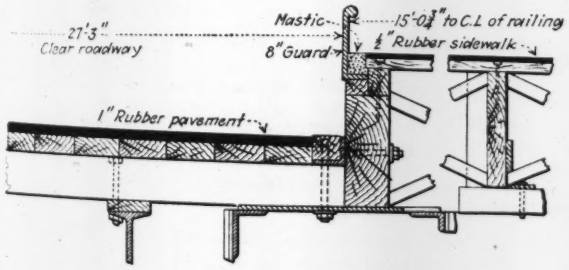
The 12-ft. diameter penstocks are rounded off at the entrance making the total area to be covered by the gates 13 ft. in diameter. The gate frames are of cast iron bolted to the existing concrete and grouted. The gates are of structural steel operated either by hand or motor.

Two of the existing penstock stubs are drawn together as shown in Fig. 6 to form one 12-ft. diameter penstock for the new vertical turbines. The penstock plates are ½-in. steel.

Scrollcase—Where the penstock enters the scrollcase it is reduced in diameter to 11 ft. The scrollcase is of reinforced concrete designed for a head of 102 ft., including water hammer at 2 sec. time of closing. Bars 1 in. and ¾ in. in diameter are used throughout for the circular and longitudinal reinforcing, the size of the bars and the spacing being changed to suit the changing stresses. The method of anchoring the circular reinforcing bars is shown in the enlarged section in Fig. 6. This arrangement was adopted to minimize the massing of steel at the speed-ring. Concrete of a 1:2:4 mixture was used and 25 lb. of hydrated lime per yard was added for waterproofing. Care was taken in the design to see that concrete was not less than 4 ft. thick in the larger cross-sections and 3 ft. in the smaller.

Rubber Paving and High Curb Guards on Chicago Bridge

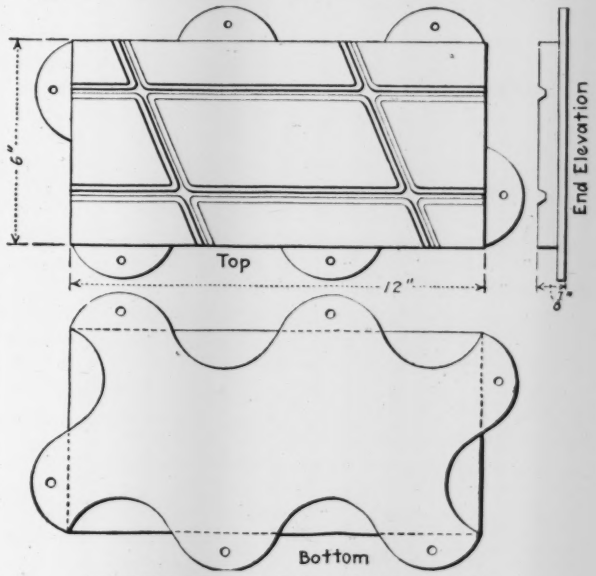
TWO NOVEL improvements made recently on the Michigan Ave. bascule bridge over the Chicago River are the laying of rubber tile paving and the placing of a high guard along each curb to prevent automobiles from riding up on the sidewalks if they get out of control.



BRIDGE FLOOR WITH RUBBER PAVING AND STEEL CURB GUARD

The rubber tiles, made of a composition of new rubber and old automobile tires ground together, are 6x12 in. in size, with thickness of ½ in. and ¾ in. for the sidewalks and roadways respectively. Each tile has the lower portion made in scalloped shape, as shown in the drawing, to form alternating projections and recesses which interlock, as the tiles are laid to break joints. For the sidewalk, each tile has two grooves lengthwise, so that the completed paving has transverse corrugations. For the roadway, there are also diagonal corrugations, which are in opposite directions on adjacent tiles, thus forming a series of longitudinal wavy corrugations. This arrangement was designed specially for the Michigan Ave. bridge, to meet the problem of skidding. A bridge at Boston is laid with alternate rows of flat blocks and blocks grooved like the sidewalk blocks. In laying the pavement, the plank flooring is mopped with hot pitch as each tile is placed and the tile held in position by a crowbar while drive-screws are driven into the projecting lugs. By pushing the blocks into place, enough pitch works up to fill the joint.

For the two roadways, the present 5½-in. transverse sub-planking will be covered with three-ply roofing felt, mopped with hot asphalt, upon which will be 3x4-in.



RUBBER TILE FOR ROADWAY PAVING

fir planks, laid longitudinally and with ¼-in. spaces. The sidewalks will have the old planking replaced with transverse 3x4-in. fir strips laid across the longitudinal joists and nailed in place. The rubber tiles are laid directly on the planking.

An 8-in. 18-lb. bulb angle is placed along the curb stringer, as shown by the drawing, giving a clear height of about 15 in. from roadway to top of guard.

All construction was done by the forces of the Department of Public Works, using tiles furnished by the Wright Rubber Products Co., Racine, Wis. The work is under the direction of John Ericson, city engineer, and T. G. Pihlfedt, engineer of bridges, with F. H. Avery, engineer of bridge construction and repair, in direct charge.

City Managers Adopt Code of Ethics

A code of ethics was adopted by the International City Manager's Association at its recent annual convention. The code, which was drawn by a committee headed by Ossian E. Carr, city manager, Dubuque, Iowa, deals with matters of integrity on the part of managers, and with their attitude towards the council and the public. Under the code, a manager *must not* take an active part in politics, and *must* "exercise his own judgment as an executive in accomplishing the policies formulated by the council." The code is printed in the October *City Manager Magazine* (Lawrence, Kan.).

Joint Conference Adopts Two New Standard Contract Forms

Forms for Building and Engineering Construction Contracts Issued by Conference But Not Yet Adopted by Constituent Societies

THE JOINT Conference on Standard Construction Contracts, organized nearly three years ago, has finally approved two standard contract forms, one entitled "Standard Contract for Construction of Buildings," the other "Standard Contract for Engineering Construction." The two documents are similar in general principles and in form, the main difference being that in the building contract the architect appears as the technical agent and in the engineering construction contract form the engineer. This does not mean, however, that the wording is exactly the same, because the two types of construction involved have required some differences in text and treatment.

The societies represented in the conference, together with their representatives, are as follows: American Association of State Highway Officials, H. K. Bishop; American Engineering Council, George R. Putnam; American Institute of Architects, William Stanley Parker; American Railway Engineering Association, W. D. Faucette; American Society of Civil Engineers, J. S. Langthorn; American Water Works Association, J. Waldo Smith; Associated General Contractors of America, J. W. Cowper and R. C. Marshall, Jr.; and Western Society of Engineers, Onward Bates. Ward P. Christie, of the Associated General Contractors, was secretary. So far, none of the associations has approved the final drafts, although several of them have expressed approval of the second draft and have made certain criticisms, most of which were embodied in the third and final drafts. The status of the contracts in the constituent societies is as follows:

American Association of State Highway Officials—No definite action taken, as it is not clear to this association just what approval of the documents would mean. Standard forms probably could not be used by state highway officials because of state laws which conflict.

American Engineering Council—Approved second draft contingent upon the building form being printed also with word engineer substituted for word architect.

American Institute of Architects—Left decision to the Executive Board, which apparently will withhold approval until the engineers generally show an inclination to use the engineering form.

American Railway Engineering Association—Has been opposed to the contract being made standard for railroad work, particularly on account of the arbitration provisions noted hereinafter. The association has not adopted either form. So long as the engineering form is not designated as a railroad standard, there is a probability that the association will at least not oppose its general use.

American Society of Civil Engineers—Has taken no action.

American Water Works Association—Approves the second draft as a statement of principles; has taken no further action.

Associated General Contractors of America—Approved the final draft.

Western Society of Engineers—Approved the second draft contingent upon certain minor changes which the conference feels have been complied with in the third draft.

Publication Rights—It should be noted that the American Institute of Architects has a special interest in the contract form. That institute has for some years published a standard contract for the construction of buildings as a copyrighted publication and has sold a great number of them to the financial advantage of the institute. The standard contract proposed by the conference is very similar to that of the American Institute of Architects and on that account the copyright in the document, together with the copyright in the standard contract for engineering construction (which is not exactly like the architects' form as noted above) has also been placed in the hands of the American Institute of Architects, which will presumably issue the documents as a commercial proposition.

It is therefore apparent that in favorably considering the contract forms each constituent society must do one of two things—either approve the documents or adopt the documents. If they approve them, it means only that the society in question approves the principles stated and considers them acceptable for the particular class of work involved; if they adopt them, it means that they are to be issued by that society as a document. For example, the American Institute of Architects can approve both of the new documents and can adopt the building form, whereas the American Association of State Highway Officials could adopt neither of the forms, but might approve the engineering form. Meanwhile, however, as the matter now stands, any society which adopts the form would have to make some arrangement with the American Institute of Architects for issuance of the form because of the copyright privileges that society holds.

Arbitration Provisions—The most contentious part of the conferences which led up to the adoption of the contract by the joint conference was on the matter of arbitration. In its final form, the conference has this to say regarding arbitration:

In the present documents, the right of arbitration is limited to matters of time and financial consideration, thus reserving to the architect or engineer final decision in technical and other matters. This type of arbitration, the form most widely approved in the associations represented, is believed to have overcome the principal objections to the use of arbitration in construction.

The clauses in the engineering form relating to arbitration are as follows:

Art. 39. Engineer's Decisions—The engineer shall, within a reasonable time, make decisions on all claims of the contractor and on all other matters relating to the execution and progress of the work or the interpretation of the contract documents.

All such decisions of the engineer shall be final except as to the element of time and the financial considerations involved, which, if no agreement in regard thereto is reached, shall be subject to arbitration.

Art. 40. Arbitration—All questions subject to arbitration under this contract shall be submitted to arbitration at the choice of either party to the dispute.

The contractor shall not cause a delay of the work during any arbitration proceedings, except by agreement with the engineer.

The demand for arbitration shall be filed in writing with the engineer, in the case of an appeal from his decision, within ten days of its receipt and in any other case within a reasonable time after cause thereof and in no case later

than the time of final payment except as otherwise expressly stipulated in the contract. If the engineer fails to make a decision within a reasonable time, an appeal to arbitration may be taken as if his decision had been rendered against the party appealing.

No one shall be nominated or act as an arbitrator who is in any way financially interested in this contract or in the business affairs of either the owner or the contractor.

The general procedure shall conform to the laws of the state in which the work is to be erected. Unless otherwise provided by such laws, the parties may agree upon one arbitrator; otherwise there shall be three, one named in writing, by each party to this contract, to the other party, and the third chosen by these two arbitrators, or if they fail to select a third within ten days, then he shall be chosen by the presiding officer of the Bar Association nearest to the location of the work*.....

.....Should the party demanding arbitration fail to name an arbitrator within fifteen days of his demand, his rights to arbitration shall lapse. Should the other party fail to choose an arbitrator within said fifteen days, then such presiding officer*.....

.....shall appoint such arbitrator. Should either party refuse or neglect to supply the arbitrators with any papers or information demanded in writing, the arbitrators are empowered by both parties to proceed *ex parte*.

If there be one arbitrator his decision shall be binding; if three the decision of any two shall be binding. Such decision shall be a condition precedent to any right of legal action, and wherever permitted by law it may be filed in court to carry it into effect.

The arbitrators, if they deem that the case demands it, are authorized to award to the party whose contention is sustained such sums as they shall deem proper for the time, expense and trouble incident to the appeal, and if the appeal was taken without reasonable cause, damages for delay. The arbitrators shall fix their own compensation, unless otherwise provided by agreement, and shall assess the costs and charges of the arbitration upon either or both parties.

The award of the arbitrators must be in writing, and it shall not be open to objection on account of the form of the proceeding or the award, unless otherwise provided by the laws of the state in which the work is to be done.

In the event of such laws providing on any matter covered by this article otherwise than as hereinbefore specified, the method of procedure throughout and the legal effect of the award shall be wholly in accordance with the said state laws, it being intended hereby to lay down a principle of action to be followed, leaving its local application to be adapted to the legal requirements of the place in which the work is to be done.

*To provide some other agency for appointing arbitrators strike out reference to presiding officer of Bar Association and insert proper designation.

New Asphalt Filler for Wire-Cut Brick Roads

ADOPTION of wire-cut brick on state roads in Ohio has required a modification of the old formula for asphalt filler to secure a mixture which will penetrate the close joint. The new formula is as follows:

(1) Asphalt filler shall be homogeneous, free from water, and shall not foam when heated to 177 deg. C. (350 deg. F.)		
(2) Specific gravity, 25 deg. C/25 deg. C.	not less than	1.00
(3) Flash point	not less than	200 deg. C.
(4) Melting point		60 to 75 deg. C.
(5) Penetration—		
At 25 deg. C., 100 g. 5 sec.		50 to 60
At 0 deg. C., 200 g., 60 sec.	not less than	25
At 46 deg. C., 50 g., 5 sec.	not over	160
(6) Ductility at 25 deg. C.		10 to 30 cm.
(7) Loss at 163 deg. C., 5 hr.	not over	1.0 per cent
(8) Total bitumen (soluble in CS_2)	not less than	99.0 per cent
(9) Per cent of total bitumen insoluble in carbon tetrachloride	not more than	1.0 per cent

Removal for inspection of pavements laid with this filler shows full penetration.

Dismantling Old Canal Involves Rebuilding Many Structures

Abandoned Morris Canal to be Drained and Streams Restored to Former Channels—Reservoir Dams to be Maintained

BY CORNELIUS C. VERMEULE
Consulting Engineer, New York City

ON THE one hundredth anniversary of the incorporation of the Morris Canal and Banking Co. to build a canal across the state of New Jersey, the canal property is in the process of dismantling preparatory to abandonment. The canal was chartered in 1824 and opened in 1831, but with boats carrying only 25 tons. Its route is from New York Bay at Jersey City, across the Hackensack and Passaic Rivers to Newark, thence north to Paterson where it turns west and runs in a southwesterly direction over the highlands between the Passaic and Delaware River valleys to the Delaware River at Phillipsburg, N. J. The canal proved to be a failure financially and was foreclosed in 1844, and thereafter enlarged to a top width of 40 ft., a bottom width of 25 ft. and a depth of 5 ft., the boats then carrying about 70 tons of freight. From that time it slowly increased its business, and for a short time during the Civil War period and up to 1870, it did a fairly profitable business.

About 1870 it was leased by the Lehigh Valley R.R. but thereafter its business steadily declined, owing mainly to diversion of its traffic to competing railroads. Its freight consisted principally of iron ore and coal, and this was diverted by the D. L. & W. R.R., which paralleled the canal throughout, and the Central Railroad of New Jersey which constructed its High Bridge Branch and diverted most of the ore traffic.

Abandonment Proposed—During the past thirty years or more, repeated attempts have been made to procure legislation permitting abandonment of the canal. In the original charter the state had reserved the right to take over the canal at a price to be determined by a commission, in 1923, or failing to do so the charter was continued to 1973, and at which date it reverted to the state without cost. The Morris Canal and Banking Co., being under these conditions a holder of a life interest, could not abandon without authority of the legislature. The necessary legislation was opposed on various accounts.

The abandonment was finally brought about through an application for an injunction brought by the canal company against the North Jersey District Water Supply Commission. Through their Wanaque development they planned to divert water from the canal, which was proved to be necessary in order to keep the canal in condition to be operated. The application for an injunction was made in 1918, and the final decree granting the injunction was filed Sept. 25, 1922. During the trial of this case a large amount of testimony was introduced, including gagings covering a period of thirty years, which showed that the canal was using ninety million gallons daily of the best potable water of the state. This water, particularly that part diverted from the head waters of the Passaic River, is all needed for public water supply.

In consequence of the injunction, an act was passed

and approved March 11, 1922, authorizing the acquisition by the state of the Morris Canal property. Subsequently an agreement was reached, in November, 1922, between a commission representing the state and the Morris Canal and Banking Co., under which the company or its lessee, the Lehigh Valley Railroad Co., retained the Big Basin in Jersey City, used and occupied by the railroad company as a terminal, also the right-of-way through Jersey City from the Hudson to the Hackensack River, and the right-of-way through the town of Phillipsburg on the Delaware. All the rest of the property, including the ninety miles of right-of-way, the water privileges and lands adjacent to the canal, became the property of the state.

Disposition of Canal Property — During the long period of over thirty years while the abandonment of the canal had been under discussion, several legislative committees had conducted investigations and reported plans for disposing of the canal. After the canal became the property of the state, early in 1923, Governor Silzer requested five citizens of the state to act as an advisory committee to recommend the final disposition to be made of the property. In addition to these five, representing the state at large, two members of the Board of Conservation and Development, which board had already been made custodian of the property by act of the legislature, and in addition six members, nominated by the counties through which the canal passes, were duly constituted a committee. They held hearings during the year and gave earnest consideration to the question referred to them. They finally reported a plan for disposing of the property and drafted a series of acts to carry the plan itno effect. The report was laid before the legislature by the Governor, and the several acts were duly passed and approved in March of the present year.

The plan provides that pending its ultimate disposition the canal right-of-way shall be declared a public highway, and that the several municipalities shall have the right of taking it over for public use at any time prior to January 1, 1925. If they fail to take over any part of it by that date it is to be offered for private purchase to the highest bidder.

The Governor's committee found a tentative value for the whole property, not including the water rights, amounting to $2,959,316. Of this $1,200,000 represented the Little Basin in Jersey City, and $1,631,000 for the right-of-way through Newark. These values, being based upon an appraisal made in 1912, are very conservative for present conditions. In the settlement the Lehigh Valley Railroad Co. also paid the state $875,000.

In order to hold together the rights and franchises, the corporation was continued in existence as the Morris Canal and Banking Co., holding the property in trust for the state. The members of the Board of Conservation and Development are made directors of the corporation. They have appointed Henry B. Kummel, general manager, and the author of this article, consulting and directing engineer, in charge of dismantling and reconstruction.

Structures to Be Maintained — The several lakes, namely Lake Hopatcong, Greenwood Lake, Lake Musconetcong, Cranberry Lake, Bear Ponds, pond at Saxton Falls on the Musconetcong, all of which are reservoirs of the canal, are to be permanently held "for the public use of conserving the public waters of the state, and shall be and are hereby dedicated to such public use." The company is directed to control, maintain and operate the various dams and sluice gates in such manner that the rights of all riparian owners shall be conserved.

The company is also authorized to consent, for a consideration to be fixed by its board of directors and approved by the Governor, to the diversion for municipal water supply of waters vested in such company.

The company is also authorized and directed to drain off the canal, to remove highway and road bridges and refill and resurface the roads at highway crossings, to repair and make safe the sluice gates at the lakes and ponds, to raze, remove or put in safe condition all other structures which may obstruct highways, roads or water courses through the fall of culverts, aqueducts, etc.

The dismantling and reconstruction work thus provided for is extensive. There are 144 highway and road bridges, which must be removed, the approaches graded down and the roads resurfaced. There are 19 planes, 28 locks, 9 aqueduct bridges, 19 foot and towpath bridges, 45 culverts, 43 spillways with sluice gates and 11 dams over the ninety miles of canal to be dismantled. Estimates for the whole work have not yet been made. Already sixty sheets of plans have been prepared for this reconstruction work. The dam at Lake Hopatcong is to be immediately rebuilt. The other work has been divided into sixteen sectional contracts, which will be let as fast as money is appropriated for the work. The dam at Lake Hopatcong, as well as that at Lake Musconetcong, and the one at Saxton Falls, will require rebuilding. The first two were never provided with spillways. The dam at Lake Hopatcong has been found to be in dangerous condition. All of the dams need extensive repairs. An offhand estimate furnished the board by the consulting engineer, gives the cost of dismantling at not less than $1,200,000. A difficult matter is the drainage of the canal and the restoration of the natural drainage to the original water courses.

This water having in many cases been diverted for a century or more, the original water courses have been encroached upon or have grown up to such an extent that throwing the water back into the original channels is often difficult and in some cases dangerous. At fully one hundred points serious questions arise in this respect.

The actual construction work is so divided at more than four hundred locations that it will require time. Probably the entire work cannot be completed in less than four working seasons.

France Establishes Test Road Sections

The French Bureau des Ponts et Chaussées has established an open-air roads laboratory on which the various types of foundation and surfacing will be tried out. The first of these sections of experimental roadway is on departmental road 20 running from Paris to Noisy-le-Grand, of which a section of 1,400 km. will be built of reinforced concrete, with various aggregates and of plain concrete; and this section will be divided into sub-sections with a variety of treatment as to joints, crown, etc. These test roads are established with a view to improving the construction of the highways of France which it is feared are fast wearing out under the increase of motor traffic.

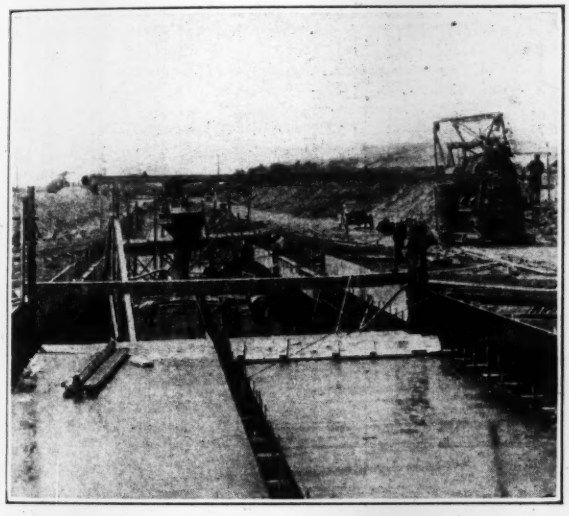
From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Crawler Paver Does Good Service on Sewer Construction Job

EFFICIENT use of a paver for other than highway construction work has been recently demonstrated on a large concrete sewer job in Milwaukee, Wis. The project upon which the pavers were used lies in the northwest section of Milwaukee just outside the city limits. Work consists in improving a large section of undeveloped land, which borders Roosevelt Drive, and in installing a drainage system preparatory to subdividing the property for residence purposes.

The work is in two sections. The main sewer is 3,200 ft. long, 8 ft. 10 in. high from the bottom to the top edge, with an opening of 6 ft. and is 19 ft. 9 in. wide. It is a two-section, square sewer, each section



PAVER POURING SLAB OF CONCRETE SEWER

of which is 8 ft. 6 in. wide. The outside walls are 1 ft. 8 in. on top, 16 in. on the bottom, with a 9-in. center wall.

Because of the width of the work, which is well over 25 ft., and its length, the Clayton Construction Co., contractors, decided to use a paver for the concrete work because of its mobility. Accordingly, a special boom, 45 ft. long, was furnished and attached to a 21-E paver. The contractor built a support which was moved as the work progressed to prop the boom at the outer end. This arrangement allowed ample room for reaching the farther side of the forms and at the same time the paver was at a safe distance from the cut.

A central proportioning plant with bins and conveyor-loader was built midway from each end of the job, so that the maximum haul of the three trucks was 1,600 ft. Work was started June 12 and completed Sept. 6. An average of 76 lin.ft. of sewer was completed each working day.

Connecting with this main double section sewer is a single section round sewer 6,000 ft. long, with a diameter varying from 6½ to 8 ft. On this job, being done by the George F. Zimmerman Construction Co., also of Milwaukee, a new 13-E paver with standard 20-ft. boom is being used, and the same construction process followed out. The sewer is built on a concrete slab 12 in. thick on the sides and from 16 to 18 in. thick in the center. At one end the sewer is built in two sections 6½ to 8 ft. in diameter to connect with the large main sewer. The remainder is a single section.

Due to the swampy nature of the ground and the large amount of water encountered in the bottom of the ditch, an extremely dry batch was used. Four shovelfuls of hydrated lime were mixed with each batch to give the concrete an additional smoothness. Since the start of the work the paver has averaged over 600 bags of cement a day. After the bottom concrete was poured, the circular forms were placed, and the concrete was poured for the sewer.

Material from which this article was written was supplied by Koehring Co., Milwaukee, Wis.

Notes on Placement of Construction Joints in Concrete Bridges

BELIEVING that many resident engineers and inspectors do not understand the proper location of construction joints in concrete bridges, A. W. Zesiger, chief engineer of the bureau of bridges of the Ohio Highways Department, recently addressed to each resident engineer a letter containing certain rules governing usual cases. Some of these rules follow:

Construction joints are always objectionable structurally, but as they cannot be entirely avoided, they should be *located* where *least* objectionable. At points where the designer expects a construction joint, he should show it on the plans. Whenever the contractor finds it necessary to make additional joints their location shall be determined by the resident engineer according to these rules, and shall never be done without his permission.

The contractor should, before beginning the pouring of any structure or portion thereof between specified construction joints, determine the capacity of his plant for that particular continuous pouring; and, if there is any doubt as to his ability to complete the pouring continuously, an intermediate bulkhead should be provided along a line of low shear and the pouring should be stopped at this line unless it is known beyond a reasonable doubt that the entire pouring can be completed without interruption.

Although the pouring of slab bridges has given little or no trouble because the yardage is small, nevertheless the same rules govern. However, if a construction joint is required on a slab bridge, it is more practical to make the joint parallel to the direction of the main steel instead of making it along a line at the center of the span.

Many mistakes have been made in the pouring of concrete beam bridges by pouring the beams up to the bottom of the slab and later pouring the slab. This is wrong. These beams are designed as T-beams and the slab is a part of the beam. The slab and beams (including curb on outside beams) must be poured continuously. If it is impossible to pour a complete span in one continuous operation, make a longitudinal construction joint (or joints) in the slab midway between any two beams.

Most mistakes, we believe, have been made on concrete girder bridges. Several kinds of horizontal joints have been made which are wrong. If it is impossible to pour a complete span in one continuous operation, make a construction joint along the center line of the roadway, placing

a vertical bulkhead for both slab and floorbeams. Then pour one-half continuously including slab, beams and girder. If it is impossible to pour one-half continuously, place the center-line bulkhead as explained above and also a transverse vertical bulkhead at the center of the span for slab and girder and then pour one-fourth continuously. (If there happens to be a floorbeam at the center of the span, the transverse vertical bulkhead shall be placed in the center of the panel on either side of the center of the span). In case of a transverse construction joint care shall be taken to prevent the formation of a "lip" on the concrete of the part of the girder first poured. No construction joints except those explained above shall be made.

Construction joints in the ribs or ring of a concrete arch bridge shall be normal to the direction of the thrust which is generally radial. Whenever the designer has not shown the location of joints on the plans, it would be advisable for you to ask the Bridge Bureau to specify the location of the joints.

Construction joints in reinforced-concrete abutments should be shown on the plans. In cases where not shown, ask the advice of the Bridge Bureau. Horizontal joints should never be made near the normal water level. Construction joints for gravity abutments shall be determined in advance and placed vertical.

A key or dovetail of proper size should be provided at all construction joints. The projection of key should be about 1 in. for thin slabs and 2 in. for thick slabs and beams and girders. The thickness of key should be about one-fourth the thickness of slab, beam or girder (if square) and one-third if beveled. Bevel should be about two to one.

Securing Visibility Over Hills on Public Highways

By H. A. Marshall
Eldmann & Marshall, Consulting Engineers, Topeka, Kansas

With the idea in mind of greater safety for the traveling public, more attention is being devoted to the proper length of vertical curves at the tops of hills in Kansas highways. Primary highways are being designed to provide for a clear vision over hills from two approaching vehicles of at least 500 ft. The minimum vision allowance on secondary highways is 350 ft.; however, all highways are being designed to allow 500 ft. vision where this provision does not involve too much expense as compared to the traffic received by the road.

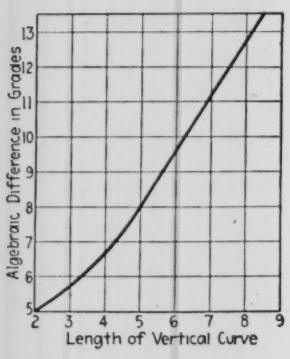


CHART GIVES VERTICAL CURVE LENGTHS FOR VISIBILITY OF 500 FT.

The curve herewith has been plotted by the writer to be of assistance in designing highways to provide 500 ft. of clear vision over hills.

Example: A positive 6 per cent grade intersects with a negative 6 per cent grade. Determine the length of a vertical curve to give a clear vision of 500 ft. from two approaching automobiles.

Solution: The algebraic difference of the two grades = 12. Enter the vertical axis with twelve and follow across to the intersection with the curve. From the point of intersection with the curve drop down to the horizontal axis and read the result, which in this case is 7.5

Therefore, the length of the vertical curve must be 750 ft. to give a clear vision of 500 ft.

From Job and Office

Hints that Cut Cost and Time

Computing Contents of Horizontal, Cylindrical Tanks

By Arthur M. Shaw
Consulting Engineer, New Orleans, La.

In view of the fact that many engineers are called on to prepare tables or graphs, showing the contents of horizontal, cylindrical tanks, filled to varying depths, the inclosed tabulation of percentages of depth and volume is submitted as being more suitable for such purpose than the method of computation by the formula for solution of areas of segments of circles or by the usual tables based on such formula.

The tabulation submitted is published (in a slightly different form) in the "Useful Data" section of "MacRae's Blue Book." While it is possible that it is available in some of the various engineers' handbooks it has never come to my attention from such sources.

TABLE—CONTENTS OF HORIZONTAL CYLINDRICAL TANKS

Per Cent of D	Q	Per Cent of D	Q	Per Cent of D	Q	Per Cent of D	Q
1	.1759	26	20.6502	51	51.2732	76	81.5334
2	.4799	27	21.7792	52	52.5440	77	82.6268
3	.8782	28	22.9195	53	53.8137	78	83.6923
4	1.3480	29	24.0633	54	55.0868	79	84.7362
5	1.8665	30	25.2298	55	56.3599	80	85.7654
6	2.4509	31	26.3996	56	57.6251	81	86.7707
7	3.0795	32	27.5729	57	58.8846	82	87.7579
8	3.7501	33	28.7711	58	60.1475	83	88.7281
9	4.4627	34	29.9762	69	61.4002	84	89.6796
10	5.2025	35	31.1926	60	62.6461	85	90.5933
11	5.9832	36	32.4061	61	63.8965	86	91.4886
12	6.7979	37	33.6340	62	65.1333	87	92.3511
13	7.6489	38	34.8667	63	66.3660	88	93.2021
14	8.5114	39	36.1035	64	67.5939	89	94.0168
15	9.4065	40	37.3539	65	68.8074	90	94.7975
16	10.3234	41	38.5998	66	70.0238	91	95.5373
17	11.2719	42	39.8525	67	71.2289	92	96.2499
18	12.2421	43	41.1154	68	72.4271	93	96.9205
19	13.2293	44	42.3749	69	73.6004	94	97.5491
20	14.2346	45	43.6401	70	74.7702	95	98.1335
21	15.2638	46	44.9132	71	75.9367	96	98.6520
22	16.3077	47	46.1863	72	77.0805	97	99.1218
23	17.3732	48	46.4560	73	78.2208	98	99.5201
24	18.4466	49	48.7268	74	79.3498	99	99.8241
25	19.5501	50	50.0000	75	80.4499	100	100.000

In its practical application to a specific case, a graph is prepared, with units of depth as one co-ordinate and of volume as the other. Excepting where extreme accuracy is required, it will be found sufficiently accurate to compute and plat the volume at each 5 per cent interval, excepting that from zero to 5 per cent and from 95 to 100 per cent each individual per cent space should be platted.

If the information is required in the form of a tabulation, the quantities at various depths are read directly from the graph and tabulated, provision for reading to the desired minor subdivisions of the depth scale being made by adopting a suitable scale for the graph.

In the case of tanks with dished ends, correction is to be made to cover the increase (or decrease) provided by the curved ends. This correction is so slight, as compared to the total capacity of the tank, that a special graph, prepared from the computation of only a few intermediate points, will be sufficiently accurate for most cases. This correction should be added to the quantities computed from the percentage table, before platting on the final graph.

From Job and Office

For Contractor and Engineer

To use the table herewith let:

d = Diameter of tank
h = Depth of fluid in tank
$D = \frac{h}{d}$ expressed as a percentage
c = Total capacity of tank
a = Amount of fluid in tank
$Q = \frac{a}{c}$ expressed as a percentage.

EXAMPLE: Assume a tank 60 in. in diameter by 10 ft. long, filled to a depth of 24 in., then:

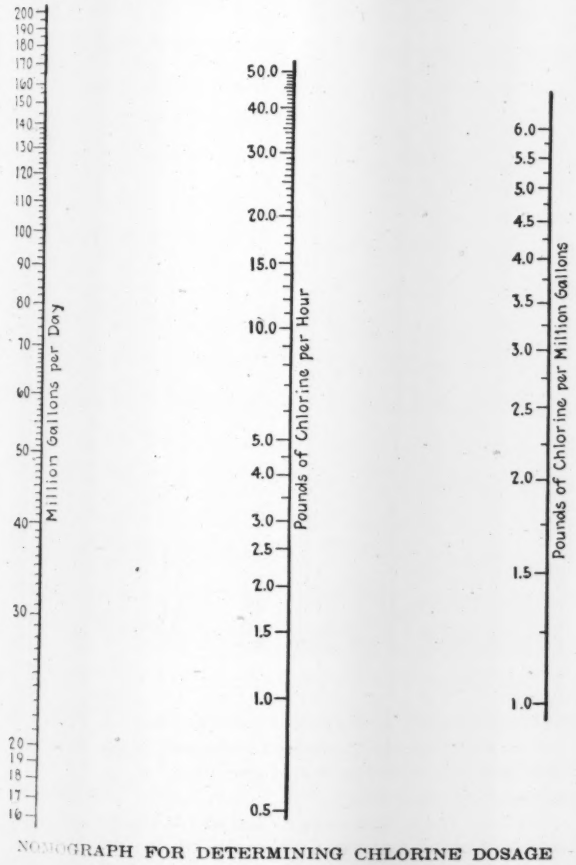
$$\frac{F}{d} = \frac{24}{60} = 40 \text{ per cent.}$$

Opposite 40 per cent in D column is 37.3539 per cent, to be multiplied into "c" (1,469 gal.) = 547 gal., the contents at 24-in. depth.

Determining Chlorine Dosage Graphically

BY W. M. OLSON
Junior Engineer, Department of Health, Chicago, Ill.

THE accompanying nomograph was designed to facilitate the calculations required for the checking of daily reports of chlorine treatment submitted to the Chicago Department of Health. The relation between water pumped in million gallons per day, the chlorine dosage ordered in pounds of chlorine per million gallons, and the actual amount of chlorine required in pounds of chlorine per hour is expressed graphically. If two of the factors are known the other may be determined by laying a straightedge over the scaled representation of the known quantities and reading the third quantity on the proper scale.



NOMOGRAPH FOR DETERMINING CHLORINE DOSAGE

For example, if water is being pumped at the rate of 60 m.g.d. and chlorine is to be applied at the rate of 2 lb. per m.g., it will be necessary to apply 5 lb. of chlorine per hour.

In the preparation of this diagram the method used was that given by H. E. Babbitt in the 1916 "Proceedings" of the Illinois Society of Engineers.

Use of "Shoo-fly" Tracks in Eliminating Tunnels; Southern Pacific Ry.

THE USE OF shoo-fly tracks to carry main-line traffic during the elimination of tunnels has been a feature of line-revision work on the Southern Pacific Ry. In early railroading it was often cheaper and quicker to drive tunnels through mountain spurs or ridges than to go around these obstacles by means of deep cuts and high fills. But as these old tunnels were of comparatively small section, their enlargement and concrete lining becomes necessary to adapt them to modern conditions.

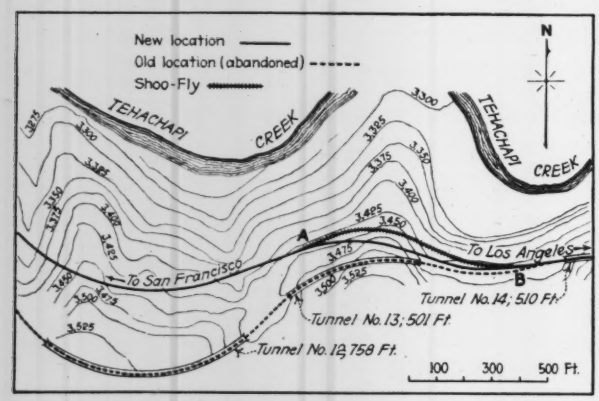
Since work of this kind involves high cost and many difficulties, being done under conditions of dense traffic, the engineer often seeks the alternative of a line revision to avoid the tunnel. Excavation for such realignment may encroach on the side of the tunnel or may even include the entire section. In such a case, a shoo-fly is built outside of the reconstruction work in order to maintain traffic. This problem of whether to adopt tunnel enlargement or line revision is not as simple for the engineer as it might appear, for he has not only to compare the respective costs but has also to consider the safe and continuous operation of trains and to exercise judgment and skill in planning and carrying out the new work in rough country.

Grading for the new permanent line outside of the tunnel is the first step, the construction trains passing around the point and making the fill required on a steep hillside. While this work is in progress, the tunnel timbering and the ground above the tunnel are watched carefully. Track is laid and ballasted on the new subgrade adjacent to the tunnel. Meanwhile, the steam shovels in the cut continue to work in closer to the side of the tunnel. When the timbering begins to show distress by slight cracking sounds and when measurements by plumb-bob indicate a movement downhill, traffic is diverted to the outside shoo-fly track, the steam shovels then attacking the cut vigorously and the tunnel being allowed to collapse.

An example of work of this kind is shown in the accompanying plan of a stretch of line revision which eliminates two old tunnels. Here the critical situation developed as the steam-shovel excavation approached the east end of tunnel No. 13. Permanent alignment between points *A* and *B* could not be secured until the new cut had opened up or dug away the tunnel. In order that train operation might not interfere with the construction work, it was desirable to keep main-line tracks operating on the original alignment through tunnel No. 13 as long as possible. Hence the necessity for careful

watch of the tunnel timbering, so as to be prepared to put the shoo-fly into operation quickly. It is considered a good rule to reduce to a minimum the time during which main-line trains operate over a shoo-fly, so that while the shoo-fly *A-B*, shown on the plan, was ready for service, it was not desirable to utilize it until conditions made it necessary to do so.

Furthermore, construction trains handling material



SHOO-FLY TRACK ON LINE REVISION AT TUNNELS

excavated by the steam shovels had to cross the main-line current of traffic as soon as the shoo-fly was placed in operation, since the point opposite tunnel No. 13 was cut away and construction trains passed around this point on sharp curvature in order to make a fill on the steep hillside between tunnels 13 and 14.

The above description is from information furnished by W. H. Kirkbride, engineer of maintenance-of-way and structures, Southern Pacific Ry., and from a paper read by him before the San Francisco section of the American Society of Civil Engineers. For each case of this kind the engineer must work out the details of the problem before deciding to abandon the tunnel, and Mr. Kirkbride has sometimes found it necessary to reject a proposed tunnel elimination because uninterrupted service for traffic could not be guaranteed. A case of line improvement on the Louisville & Nashville R.R., which involved the elimination of a tunnel, was described in *Engineering News-Record*, June 8, 1922, p. 952.

Bureau Standards' Tests Show Red Traffic Light Most Easily Seen

THAT red signal lights are most easily distinguished from other colors at a distance and require the lowest light intensity for unmistakable recognition, is one of the conclusions drawn from an investigation of the visibility of traffic signals conducted by the Bureau of Standards, Department of Commerce. Green signals came second on the list of colored lights easy to identify, but for street traffic a yellow green is considered preferable to the blue green used on the railroads. Blue ranked third on the list, but was found to require the highest intensity. The railroad yellows, it was found, were often mistaken for orange and red, and a lemon yellow gave much better results.

Several thousand observations were made at distances of 600, 900, and 1,250 ft., using different observers. They were made under daylight conditions, under which the identification of colored lights is most difficult. On the average, a red light of 75 cp. could be identified at 600 ft., while a green light had to be of 250 cp., a yellow 750, and a blue light 1,000. At 900 ft. the requirements were 100, 250, and 1,500 cp. respectively, while at 1,250 ft. they were 1,500, 2,500, 3,000 and 7,500.

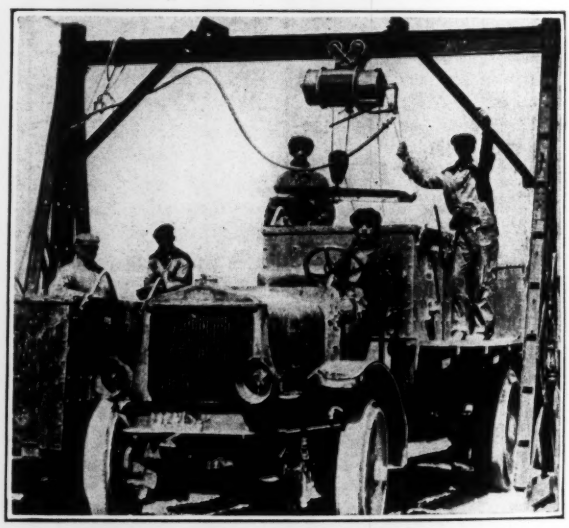
The tests are a part of a program of standardization of colors for traffic signals in which the bureau is co-operating with the American Engineering Standards Committee, the National Safety Council, and the American Association of State Highway Officials. Under the auspices of these organizations a committee has been formed which has now nearly completed a code for colors of traffic signals and for lights for building exits. This problem includes the use of colored lights on highway vehicles, along highways, and at highway crossings of steam and electric railways; the co-ordinated relation of color, form, position, and number of signals, and their relation to systems of flashing, moving, or other lights; and methods of specifying or defining colors for signal purposes.

From Job and Office

Hints that Cut Cost and Time

Effective Use of Air-Driven Hoist

THE Hill & Hill Construction Co., recently engaged in the construction of a stretch of concrete highway near East Orwell, Ohio, met considerable difficulty in transportation of road material. Though a railroad ran alongside the new roadway, the use of this means of transportation involved heavy expenditures if materials were to be handled by manual labor, inasmuch as it would have been necessary to load them first on motor trucks at the storage plant, transfer them to



AIR HOIST FACILITATES MATERIALS HANDLING

railroad cars in the freight yards, then to place the load once more onto trucks at the scene of operation. Handling of materials was facilitated in the following fashion:

Concrete materials were mixed at the plant and transported in steel hoppers to the site of the construction. The loaded hoppers were lifted onto and off the railroad

From Job and Office

For Contractor and Engineer

cars by a 4,000-lb. capacity air-motor hoist drawing operative air from a 4½x4-in. portable compressor. The hoist was suspended from an I-beam by a four-wheel trolley.

The I-beam was supported on structural steel legs, the legs and beam forming a horse large enough to straddle both a motor truck and a freight car. This arrangement made it easy to shift the loaded hoist along the I-beam from the freight car to the truck or vice versa. An air-driven motor was geared to the trolley wheel.

In operation, a slight pull on a chain started the trolley motor and spotted the hoist over the hopper, to which the hook block was then fastened. A slight pull on another chain started the hoist and lifted the load, while an automatic brake held it in suspension. A pull on a third chain moved the hoist and its load along the I-beam to the desired position, and a pull on a fourth chain lowered the hopper. In this way, one or two men were able to do the work which would have required a dozen men had it been done by manual methods.

The information contained in this article was supplied by the Ingersoll-Rand Co.

Specially Equipped Truck Places Stone for Bank Protection

IN ORDER that rapid handling of rock from cars to embankment might be secured, the California Highway Commission fitted motor trucks herewith shown,

DERRICK TRUCK FOR UNLOADING RIP RAP ROCK

the work being a rush job of shore protection along the Coast boulevard north of Santa Monica. Heavy seas and high tides had undermined a considerable stretch of the road, endangering the paved highway. To prevent further encroachment of the waves approximately 2,000 tons of heavy granite rip rap, two- to five-man size, were placed by maintenance crews of Division 7.

Trucks used for hauling the heavy rock were equipped at the division shops at Lankershim with a stiff-leg boom, provided with chain block and stone hooks, which greatly facilitated the work. An incline chute, hinged to the side of the truck and supported by posts when in use, was employed where it was necessary to chute the rock over high embankments.

According to a recent issue of *California Highways*, the official organ of the state highway commission, rock was unloaded from flat cars, hauled an average of three and one-half miles, and placed in position at a cost of 94 cents per ton.

Job and Office Notes

Tests of a Rigid Armor Diving Apparatus recently carried out in Germany, according to the journal *V. D. I.* of Oct. 11, were successfully extended to a depth of 525 ft. (160 m.) The body portion of the apparatus is a rigid shell with separable flange coupling near the waist line, and ball-jointed arm and leg portions. Air supply and purification devices are attached. A ballast tank around the body enables the diver to adjust trim or to make the entire apparatus buoyant.

Expansion Joints Developed in the state highway department are being used on California's highways. Patent joint fillers which had previously been used were found unsatisfactory as well as too expensive. The filler now used is a combination of sawdust and asphalt, inexpensive and efficient according to department engineers. Expansion joints are now placed at 100-ft. intervals instead of at the end of a day's or half-day's pouring as has been the general rule heretofore.

"On Page 275 of the Aug. 14 Edition of your periodical," writes J. R. Rogers, of Holley, N. Y., "there is an article by Marvin C. Nichols describing a convenient method of marking paving brick for culling. I would like to offer him an improvement on his device and one which we found the best on some 300,000 sq.yd. of brick laid over a period of ten years. A piece of bamboo fish pole of convenient length and size was split a distance of about 3 in. in the form of a cross. A piece of ordinary blue crayon was inserted in the end and held in place by a string or rubber band wrapped around the section holding the chalk or by a thin wire ring twisted on with pliers. The advantage of the bamboo lies in its simplicity, cheapness, lightness and possibility of the use of ordinary engineers' marking crayon which does not wash off under rain, whereas the carpenters' chalk is very soft and undependable."

Old Drainage Ditches As a Rule have lost much of their efficiency, as they fill up gradually by silting and the caving of slopes so that the water level is raised and tile outlets become choked or submerged. Of 2,000 miles of open ditches in Wisconsin 500 miles are in need of cleaning, according to the quarterly report of E. R. Jones, state drainage engineer; crops upon which labor was expended for plowing, seeding and cultivating have been lost by this cause during the present season. Since the material to be removed is generally less than 50 cu.yd. per hundred linear feet, it is too expensive for dredging and the best bid obtained in September for a job of 30,000 yards was 22c. per cubic yard, or about $2 per rod. In an experiment with pyrotol, the explosive salvaged from war material, sticks of pyrotol were placed 18 in. apart and 2½ ft. deep along the bottom of the ditch; dynamite was used to propagate the detonation between the sticks. For each 100 ft. there were required 20 lb. of pyrotol, 16 lb. of dynamite and $1 for labor. A ½ mile of ditch filled to 3 ft. was cleaned out to a 6 ft. depth at a cost of $1 per rod. The pyrotol is available at the actual cost of cartridging and shipping, the U. S. Government making no charge for the material, which is distributed through the College of Agriculture at the Wisconsin State University.

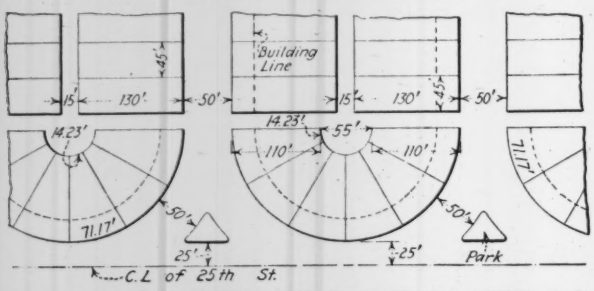
Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Street Intersection with Curved Layout

Sir—An article on a street intersection with curved layout appears in *Engineering News-Record* of Oct. 9, 1924, p. 599, and in order to show you that the idea has been used previously I am enclosing a print of Terre Town, a subdivision made by me, which is on record in the recorder's office of this (Vigo) county. This subdivision is an addition to the city of Terre Haute and the date of the acknowledgment, Dec. 13, 1922, would show you when the plat was made.

The writer had the same idea regarding traffic and the arrangement of frontage; also the elimination of the rear



CURVED STREET INTERSECTION AT TERRE TOWN, IND.

of the corner lot coming opposite to the side of the lot across the alley. Probably Mr. Schmitt never heard of Terre Town, and I would not be surprised if other engineers had devised the same plan for the same reasons set out in the article.

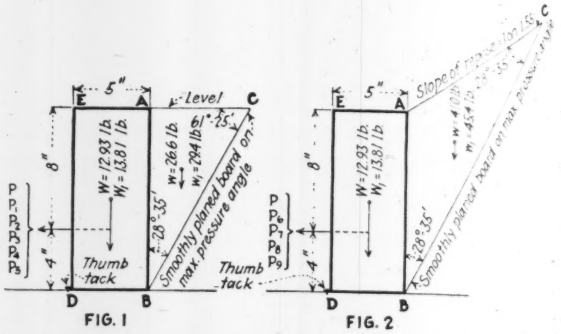
W. R. PAIGE,
Consulting Engineer.

Terre Haute, Ind.,
Oct. 24, 1924.

Tests of Sand Pressure Against Walls

Sir—Failure some months ago of a retaining wall 40 ft. high, supporting material which was principally dry sand, suggested an investigation of the pressure of sand filling against walls for the purpose of ascertaining the horizontal resultant at one-third the height of a wall above its base of all of the forces against the wall resulting from sand pressure, involving the resultant of the actual horizontal pressure of the sand wedge and the vertical component set up by the friction between the face of the wall and the sand.

As indicated by the data on the blueprint it should be noted that there is material friction adding greatly to the stability of a wall even when such friction is the result



MODEL USED TO TEST STABILITY OF WALL

ABDE is a block of smoothly planed wood. *ABC* is sand filling behind block. Area exposed to pressure 12x12 in. W = weight of block. W_1 = weight of block with roofing on back. w = weight of loose dry sand. w_1 = weight of compacted dry sand.

of the pressure of clean, dry sand upon a smoothly planed wood surface with the wood grain running vertical. On an ordinary masonry face the friction would be considerably greater as indicated by the higher frictional resistance set up by covering the back of the test wall with one layer of roofing material having a slate covered surface. All engineers are familiar with such a slate surface on roofing material. The friction between this roofing surface and the sand is probably greater than between sand and a smooth concrete surface, but the friction on the ordinary concrete surface of a concrete wall would certainly be materially greater than on smoothly planed wood.

I think this statement in connection with the data set forth on the blueprint is all that is necessary to enable engineers to analyze the experiment intelligently.

J. L. CAMPBELL,
Chief Engineer, El Paso & Southwestern System.

El Paso, Texas,
Aug. 28, 1924.

OVERTURNING PULL AT ONE-THIRD HEIGHT OF THE BLOCK

P = Overturning pull on block without sand filling.
= 7.5 lb. without slate surfaced roofing on back. Average of 10 pulls, no variation.
= 8.5 lb. with slate surfaced roofing on back. Average of 10 pulls, no variation.

P_1, P_2, P_3, etc. = Overturning pull on block with sand filling.

P_1 = dry and loose, = 3.12 lb. = av. of 10 pulls, Hor. thrust of sand = 4.38 lb. concentrated on line P.

P_2 = dry but compacted, = 16.3 lb. = av. of 5 pulls. Stability increased 117 per cent.

P_3 = dry and loose but with roofing on back, = 6.10 lb. = av. of 5 pulls. Hor. thrust = 2.4 lb.

P_4 = dry but compacted, with roofing on back, = 20.50 lb. = av. of 5 pulls. Stability increased 141 per cent.

P_5 = wet and compacted, with roofing on back = 32.50 lb. = av. of 1 pull. Stability increased 282 per cent.

P_6 = dry and loose, = 0.3 lb. = av. of 10 pulls. Hor. thrust = 7.2 lb.

P_7 = dry but compacted, = 15.6 lb. = av. of 5 pulls. Stability increased 108 per cent.

P_8 = dry and loose but with roofing on back, = 3.10 lb. = av. of 5 pulls. Hor. thrust = 5.4 lb.

P_9 = dry but compacted, with roofing on back, = 26.0 lb. = av. of 5 pulls. Stability increased 206 per cent.

	Overturning pull in pounds				Overturning pull in pounds		
	Max.	Min.	Av.		Max.	Min.	Av.
P_1	3.62	2.75	3.12	P_6	0.75	.0	0.3
P_2	17.50	14.75	16.30	P_7	16.25	14.75	15.6
P_3	6.50	5.87	6.10	P_8	3.25	3.00	3.1
P_4	22.00	18.50	20.50	P_9	28.00	25.50	26.0
P_5	32.50	32.50	32.50				

Tests of Semi-Circular Notched Weirs at Colorado Experiment Station

Sir—It has proved interesting to the writer to compare the results given by Prof. F. W. Greve in his article entitled "Semi-Circular Weirs Calibrated at Purdue University," *Engineering News-Record*, July 31, 1924, p. 182, with work of others on this same type of weir.

A total of 84 tests was made by V. M. Cone on circular notches 0.4995, 1.0025, 1.5011, and 1.9990 ft. in diameter, at the laboratory of the Colorado Experiment Station at Fort Collins. The results were published in the Journal of Agricultural Research, U. S. Department of Agriculture, March 6, 1916.

The Purdue experiments agree within 1 per cent with those performed by Mr. Cone throughout the entire range of heads experimented upon, and under most conditions the agreement is much closer. It is gratifying to find that two experimenters working independently and with entirely different apparatus check each other's results so closely and it gives one renewed confidence in the much-questioned accuracy of the weir as a means of measuring water.

FLOYD A. NAGLER,
Associate Professor of Mechanics and Hydraulics, State University of Iowa.

Iowa City, Oct. 27, 1924.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Hunt Re-Election Enlivens Colorado River Problem

Arizona Governor Against Seven-State Compact—Power Commission Awaits Final Decision

Washington Correspondence

With the Colorado River compact as the chief issue in the state campaign, Arizona re-elected Governor Hunt on Nov. 4. This is believed to end all hope of ratifying the interstate treaty. While final action must be taken by the legislature, it is anticipated that that body will interpret the election as a mandate from the people and will preclude the ratification of the compact.

It is probable that the Federal Power Commission will withhold action on Colorado River projects until it has been established definitely that the treaty will not be ratified. The legislature will will be in session from January to April. Once that it is established that Arizona will not ratify the treaty it is expected that the commission will proceed with the granting of rights on the Colorado River.

Girand Application

A new complication exists, however, in the Girand application for rights on the Colorado at Diamond Creek. Arizona has taken a position contrary to that of any other western state in contending that Mr. Girand has lost his state rights by failure to continue construction work, regardless of the fact that he was forced to discontinue work by a federal injunction. While the Federal Power Commission is committed, morally at least, to grant the Girand license, it is entirely possible that the issuance of a license may be delayed further pending the outcome of litigation as to the validity of his state rights.

Developments may come rapidly on other phases of the Colorado River problem. Dr. Elwood Mead, the new commissioner of reclamation, has announced that he is not wedded to the Boulder Canyon dam proposal. Results of the presidential election foreshadow, it is thought, the speedy demise of the Swing-Johnson bill. A report has reached Washington to the effect that Los Angeles is planning to apply for rights in Boulder Canyon with the idea of financing the development there itself

While these various matters are being determined further engineering studies on the lower Colorado are being urged. These studies could establish more definitely than is known now the character of projects which fit best into the full development of the river. In that connection it also is being urged earnestly that immediate steps be taken to secure a treaty with Mexico to determine definitely the rights of each country in connection with the waters of the Colorado and of the Rio Grande. Treaty negotiations move slowly. Any treaty that may be drawn up is certain to provide generous treatment for Mexico. If anything is done before that treaty is ratified to increase the low water flow through the Mexican section of the river, the right of the land owners in Mexico will have been established and it may be taken for granted that none of that water will be withdrawn by treaty once that it is put to use.

Three States Vote on Gas Tax

Three states, at the general election held Nov. 4, voted on measures providing for the collection of taxes on gasolene to aid in highway maintenance. Both Minnesota and Missouri passed such taxes, though Massachusetts rejected its proposal by a 2 to 1 vote. The proposed tax in Massachusetts was two cents per gallon.

Castleton Bridge Completed

On Oct. 23 the 600-ft. main span of the Castleton bridge, the new Hudson River crossing of the New York Central R.R. south of Albany, was landed on its permanent bearings, and the span is now complete except for riveting of the stringer connections, painting and incidental finishing operations. The span was erected by cantilevering from its east pier, being held first by backstays from the 400-ft. span adjoining to the east (erected last season) and later by outboard steel bents resting on temporary pile foundations. Several successive bents were used for this temporary support of the structure, those finally in service being located at the two middle panel-points of the span. Completing the erection of the span involved a maximum projection of the steel of about 270 ft. beyond the last outboard support.

To land the span on its bearing on the farther (west) pier it was jacked up high enough to clear the blocks on the temporary bents and then was lowered down on its permanent roller bearing. The jack load on each of the two corners was about 1,500 tons. In its final condition, with erection traveler removed, the span weighs 5,500 tons. It was built by the McClintic-Marshall Co., under the direction of George W. Kittredge, chief engineer of the New York Central R.R., and H. T. Welty, bridge engineer, who designed the bridge.

The Castleton crossing and the adjoining yard and connecting line will be opened to traffic with a public ceremony on Nov. 20.

Near Half Billion for New Public Works Construction

Illinois Approves $100,000,000 for Roads—Kentucky Rejects $75,000,000 Issue

What is variously estimated at from $400,000,000 to $500,000,000 represents the total money made available for public works construction as the result of state, county and city bond issue approvals at the general election held Nov. 4. At least half of this amount was included in half a dozen or so state and city issues.

The largest state issue to pass was that of $100,000,000 authorized by the voters of Illinois for road construction. An issue of $75,000,000 for highway purposes was defeated in the state of Kentucky. New York State authorized the issuance of bonds to the amount of $15,000,000 for the improvement of state parks. New Jersey authorized $8,000,000 in bonds, authorization being given by an 8 to 1 vote, for the completion of its share of the Hudson River vehicle tunnel. South Carolina rejected a $10,000,000 bond issue for the construction of penal, charitable and educational institutional buildings, and Arizona rejected a $3,500,000 issue for paving a highway from Phoenix, Ariz., to Blythe, Calif. Another issue rejected by Arizona, small though signifiant, was one for $100,000 for the investigation of the Colorado River. The proposition to finance with state funds development of power in California streams, a proposition carrying $500,000,000 in bonds, was again rejected by the California electorate.

County Issues

Among county issues, Baltimore County authorized $1,500,000 for construction of thirty elementary schools. Multnomah County, Ore., authorized $500,000 in bonds to complete the Selwood and Ross Island bridges over the Willamette River. Construction of these bridges has been the center of considerable political contention in Portland and the county. Indictment for fraud and collusion has been found against both the county commissioners and the original designing engineers. This is part of the project for which Gustav Lindenthal was recently retained as a consulting engineer, the original designers having been relieved.

Jefferson County, Ala., and Linn County, Iowa, both authorized the issuance of approximately $2,500,000, each issue passing by a 3 to 1 majority. The Alabama county will use its money for schools and public buildings and Linn County for road construction. Harrison County, Mississippi, approved an issue of $2,000,000 for building a seawall at Gulfport.

(*Continued on p. 807*)

Interior Post Center of Cabinet Interest

F. W. Mondell Mentioned as Possible Successor to Work—Other Positions Speculated on

Washington Correspondence

Great interest is being manifested in the action which the President may taken in connection with the Interior portfolio. This department of the federal government has been much in the limelight during the past two years. Its reorganization along lines which would require legislation has been urged strongly, but the legislation has not been forthcoming. Some are of the opinion that the effectiveness of the department can be increased greatly without legislation through internal reorganization. In that connection the suggestion has been made that this reorganization should be entrusted to Herbert Hoover. It is argued that he has reorganized the Department of Commerce and has it running so smoothly that its direction relatively has become a matter of routine.

The real truth of the situation, despite all of the speculation which is going the rounds, probably is that the President is giving little thought to the personnel of the new cabinet. It is recognized as one of the most disagreeable tasks which a president must perform. It is not unusual for literally hundreds of names to be suggested for positions of high honor. Only one can be chosen which usually results in disappointment and ill-feeling on the part of many of the friends of the others. The pulling and hauling over these jobs which will take place during the next three months will consume much of the President's time and perhaps destroy much of his peace of mind.

Mondell Mentioned

Insofar as the Interior Department is concerned there is no definite information as to the desire of Doctor Work to continue and no intimation has come from the White House that a change will be made. The name of Frank W. Mondell has been mentioned for this place. He is one of the wheel-horses of the Republican party, but the probabilities are that his conception of conservation would preclude his selection for that post.

An appointment is expected in the near future to fill the vacancy created by the death of Secretary Wallace. President Coolidge departed somewhat from custom when he asked the farm organizations to submit endorsements for the agricultural ministry. As this is written the President has before him thirty names. Each day is expected to see a lengthening of the list.

All agree that Secretaries Hughes, Mellon, Hoover and Stone will be urged to remain in the cabinet. There is reason to believe, however, that Mr. Hughes and Mr. Stone would like to resume their law practices. The probabilities indicate, however, that their retirement will not come on March 4, although they may not serve out the full four years of the term. Secretary Hoover is known to have determined to devote the remainder of his life to public service. It is generally believed in Washington that he will continue in the cabinet. Secretary Mellon is not the type that is impervious to the flood of attacks of a political, and frequently of a demagogic, character. Many of the thrusts in his direction got beneath the skin. His tax plan was defeated and many think it will be defeated again if it is presented to the new Congress. For these reasons, along with the fact that he is not a robust man, are expected to cause him to retire.

There is much talk of John L. Lewis as a possible selection for the secretaryship of labor. Since that secretary is the representative of all labor, union and non-union, some objection might come from workers outside the union as to the ability of Mr. Lewis to be their real friend at court.

Secretary Weeks has done such a good job in the War Department and it is so evident that he is happy in this work, that a change in that department is thought to be very unlikely. Secretary Wilbur is the President's own choice. He was induced to leave the bench of the Supreme Court of California to take the navy secretaryship. It is not likely that he will be changed unless a judicial post should open which appeals more to him.

Trenton Re-Advertises for Bids for New Sewage-Works

An unbalanced bid by the lowest bidder is given as the reason for rejecting all the bids received Oct. 31 for sewage-works at Trenton, N. J., and calling for new bids to be opened Nov. 28. The plant is to consist of Imhoff tanks, pumping station, outfall sewer and crib and levee work, designed by George A. Johnson and George L. Watson, associated consulting engineers, New York City. Four bids were received: Joseph L. Sigretto, Bernardsville, N. J., $1,055,441; J. P. White Co., Passaic, $1,150,680; Karno Smith Co., Trenton, $1,244,001; A. Newton Bugbee, Trenton, $1,553,579.

Susquehanna Power Seeks License for Conowingo Project

The Susquehanna Power Co. has applied to the Federal Power Commission for a license covering its 300,000-hp. development on the Susquehanna River near Conowingo, Md. The application for a license includes as a part of the project the transmission line from Conowingo to Philadelphia. The company proposes to erect a dam 90 ft. high and 4,400 ft. long. This will create a reservoir with a capacity of 12,500,000,000 cu.ft. The tail race is being excavated to tide water level. The development of this important project has been under consideration for more than sixty years. The work done by the Susquehanna Power Co. under its preliminary permit during the past two years is said to show conclusively the feasibility of the Conowingo development.

Cincinnati Adopts City Manager Plan and Small Council

Effective Jan. 1, 1926, the council-manager plan of city government was adopted by the voters of Cincinnati on Nov. 4, by a vote of nearly 2 to 1. The council will consist of nine members, chosen by proportional representation, as is the council of 25 members at Cleveland, Ohio, under the new charter that went into effect Jan. 1 of this year. The Cincinnati vote was on a charter amendment, confined to the two points just mentioned, together with the elimination of party designations from the ballots for the election of councilmen.

Two counter amendments were voted down at Cincinnati: Both provided for a reduction of the council from 32 to 9 members; one also called for election-at-large, but for councilmen designated to represent specified districts; the other was for election as well as representation by districts.

No Action on American Falls Dam Contracts

No action has been taken by the Department of the Interior on bids for the construction of the American Falls dam at American Falls, Idaho. This dam is to provide increased storage on the Snake River for supplementary supply of irrigation water; its design was shown in *Engineering News-Record* of Nov. 6, p. 741. Bids were received on Oct. 20 from the Utah Construction Co., Ogden, and Atkinson & Atkinson, Portland, covering two sizes of dam, for storage capacities of 1,040,000 and 1,740,000 acre-ft., respectively. On the low dam the Utah Construction Co. was low bidder, at the figure of $1,500,000, the other bidder being $60,000 higher. On the high dam Atkinson & Atkinson were low, with a bid of $1,920,000, the other bidder being $40,000 higher.

Bids put in by the construction department of the Bureau of Reclamation were several hundred thousand dollars lower, but it was stated by the American Falls Reservoir District Board that if interest, workmen's compensation, bonds, etc., were added the bids would be about at the level of the others. The Board decided to recommend to the Interior Department that the contract should be awarded to the Utah Construction Co., on its bid for the low dam. No action was taken on the recommendation at Washington, however, pending a decision as to the height of dam for which provision should be made in the design. Pressure of public opinion in the Snake River Valley has turned in favor of the high dam. The additional land that would be benefited by the larger storage has not yet joined the district and made payment, so that the Bureau of Reclamation is unable to contract for the high dam, but officials believe that the low dam should be so built as to permit of subsequent raising to give the larger storage. This would mean building a structure intermediate between the low and the high dams in volume and cost.

Expectations are that the work will be re-advertised.

Near Half Billion for New Construction Work

(*Continued from p. 805*)

Among the largest of the municipal issues were those authorized by Philadelphia, Baltimore, Cincinnati, Dayton and Chicago. The two issues authorized by Philadelphia totaled approximately $40,000,000, $4,124,000 being for paving and miscellaneous work and $35,726,000 for various municipal construction. This larger issue contained an item of $2,561,662 for the Philadelphia share of the increased cost of the Delaware River bridge. Other large items in the issue were $4,000,000 for the construction of a new general hospital, $1,000,000 for grading streets, $3,250,000 for construction of sewers, $5,000,000 for the extension of the water-supply system, $2,000,000 for the erection of a municipal stadium, $5,500,000 for an art museum, $5,024,338 to pay for mandamuses on opening streets, changing grades, constructing sewers and parks, and $1,000,000 for sites for the board of education building.

Baltimore authorized the issuance of $21,500,000 bonds, the largest items of which were $10,000,000 for sewers, $7,500,000 for bridge reconstruction, new bridges and grade-crossing elimination, and $4,500,000 for buildings.

The total amount of money made available in Dayton is $8,600,000 for general municipal construction. In addition a $4,000,000 issue will provide new schools. Of the larger issue, $3,000,000 is made available for a new sewage-disposal plant, $2,500,000 for water-works, and $1,800,000 for bridges. Berkeley, California, rejected a proposed issue of $2,800,000 for school construction.

A bond issue of $10,000,000, which would have made bridge construction possible in Cleveland, was defeated by a small margin. Cincinnati also rejected a $750,000 issue for the extension of the Victory Boulevard. Another municipal bond issue defeated was that in Columbus, totaling $11,450,000 and covering ten proposed construction projects, the largest of which was $3,650,000 for sewer relief work.

Chicago authorized issuance of $7,000,000, $3,000,000 each for the completion of the Grant Park Stadium and street improvements, the other $1,000,000 being for electrical improvements.

A charter amendment designed to allow the increase in funds to $3,000,000 for any one year for paving work was voted down at Detroit. Among the single municipal issues adopted were the following: Nashville, Tenn., $3,000,000 water-works extension; Harrisburg, Pa., $2,050,000, schools, roads and sewers; Cincinnati, $8,500,000, schools; Greenville, S. C., $2,000,000, water supply; Lincoln, Neb., $3,000,000, schools, and Milwaukee, Wis., $1,400,000 for a safety building for the city and county. The city of Greenville, S. C., perhaps established a record for the approval of bond issues, its $2,000,000 issue for water supply passing by a vote of 20 to 1.

In the state of Washington, the Bone bill was defeated. This was a measure drawn by advocates of municipal ownership and which would encourage more extensive power development by municipalities, facilitate the sale of municipal power outside city limits and authorize condemnation and acquisition of private properties by cities. A bill to establish a perpetual game and fish preserve along the Klamath River in northern California and for all time prohibiting the construction of "dams or other obstructions therein" was carried. This measure will prevent the development of the 500,000 hp. of power available on this stream.

A number of California cities voted extensions in public works. Oakland, Berkeley, Alameda and other East Bay cities passed a measure proposing the expenditure of $39,000,000 for a new water-supply system, (see *Engineering News-Record*, Oct. 2, p. 559) and $1,047,000 for sewers; Pasadena voted $980,000 for water-works improvements and Los Angeles $5,000,000 to open and widen certain streets.

Voters Approve Centralization of Baltimore Engineering Work

The voters of Baltimore, Md., on Nov. 4, approved the recently proposed plan for centralizing all engineering and allied work in a Board of Public Works, to include 11 bureaus in charge of water, highways, sewers, street cleaning, the harbor, buildings, mechanical-electrical matters, surveys and drafting, standards, transportation and stores. The City Council must yet act upon the plan.

RESULTS OF NOV. 4 VOTE ON OUTSTANDING BOND ISSUES

STATE, COUNTY, CITY	Amount of Issue	Uses	Result of Vote	Remarks
STATE				
South Carolina	$10,000,000	Building	Rejected	Penal, charitable, educational bldgs.
Illinois	100,000,000	Roads	Passed (2 to 1)	
Kentucky	75,000,000	Roads	Rejected	
California	500,000,000	Water-power	Rejected	
New York	15,000,000	State parks	Passed	
New Jersey	8,000,000	Tunnel	Passed (8 to 1)	Complete Hudson River tubes
Arizona	3,500,000	Roads	Rejected (2 to 1)	Paved highway Phoenix to Blythe, Cal.
Arizona	100,000		Rejected (2 to 1)	Investigate Colorado River
Alabama	Constitutional amendments passed: authority to form drainage dists.		Mobile County authorized to incur road debt	
Minnesota	Gas Tax	Roads	Passed	
Missouri	Gas Tax	Roads	Passed	Prop. No. 5, early completion state road system
Massachusetts	2-Cent Gas Tax	Road maintenance	Rejected (2 to 1)	
CITY				
Oakland (et al)	$39,000,000	Water supply	Passed	Development of Mokelumine for East Bay cities
Oakland	1,047,000	Sewers	Passed	
Los Angeles	5,000,000	Street work	Passed	To carry out first unit of $100,000,000 traffic plan
Baltimore	21,500,000	Sewers, bridges, etc.	Passed (3 to 1)	$10,000,000 sewers; 7,500,000 bridge reconstruction, etc.; 4,500,000 buildings
Nashville, Tenn	3,000,000	Waterworks	Passed (4 to 1)	Extensions
Detroit	3,000,000	Paving	Rejected	Charter amendment to increase paving app. yearly to $3,000,000
Philadelphia	4,124,000	Paving, Misc.	Passed (4 to 1)	Paving, $3,604,000
Philadelphia	35,726,000	Bridge, sewers, water	Passed (4 to 1)	
Dayton	4,000,000	Schools	Passed (3 to 1)	
Dayton	3,000,000	Sewage disposal	Passed	
Dayton	1,800,000	Bridges	Passed (3 to 1)	Total am't available, aside from schools, $8,600,000
Dayton	1,000,000	Paving	Passed	
Dayton	400,000	Sewers	Passed (3 to 1)	
Dayton	2,500,000	W. W.	Passed	
Columbus, O.	11,450,000	Sewers—general	Rejected	Largest item $3,650,000 for sewer relief
Harrisburg, Pa.	2,050,000	Schools (etc.)	Passed (3 to 1)	$1,750,000 schools; $100,000 roads; $150,000 sewers
Greenville, S. C.	2,000,000	Water supply	Passed (20 to 1)	
Cincinnati	8,500,000	Schools	Passed	
Cincinnati	750,000	Streets	Rejected (large majority)	Extension Victory Blvd.
Toledo, Ohio	3-mill tax	Municipal service	Passed (2 to 1)	
Louisville, Ky.		Sewers, Xing elim.	Passed	
Chicago	7,000,000	Stadium, sts., lights	Passed	$3,000,000 each complete Grant Pk. Stadium, sts.
Cleveland	10,000,000	Bridges	Rejected (small margin)	
Lincoln, Nebr.	3,000,000	Schools	Passed (slight margin)	
Milwaukee, Wis.	1,400,000	Bldg.	Passed	Safety building for city and county ($4,000,000 project)
COUNTY				
Baltimore	$1,500,000	Schools	Passed (4 to 1)	Elementary schools at 30 points in the county
Multnomah, Ore	500,000	Bridges	Passed (2½ to 1)	Completion of Sellwood and Ross Island structures over Willamette
Jefferson, Ala.	2,500,000	Schools, bldgs.	Passed (3 to 1)	$1,500,000 court house; $500,000 each schools and hospital
Linn, Iowa	2,332,811	Roads	Passed (3 to 1)	Complete Lincoln highway

New York Water-Power Situation Simplified by Election

Special Correspondence

One important result of the election in New York State is the clarifying of the situation in relation to development of state-owned water power. In 1921 and 1922 the Robinson Water Power Law was enacted. In brief it allowed the issuance of permits for development of state-owned water power to private corporations at such rental as might be fixed by the water power commission and conferred upon the public service commission authority to fix rates to be charged the public for electricity generated.

It also provided, however, that whenever any surplus water of the barge canal is used for such development, the plans shall be subject to approval of the superintendent of public works. It created a water power commission consisting of the conservation commissioner, the attorney-general, the state engineer and surveyor, the temporary president of the senate and the speaker of the assembly.

The commission was impeded during its first year of existence by certain defects in the law which were remedied in 1922. At the election held that year the people voted a Democratic administration into office which made the personnel of the water-power commission of that political complexion. The legislature refused to modify the Robinson law in accord with the policy of the Smith administration and the commission was obliged to function under a law with which it was not in sympathy. As a result all applications for power development pending before the commission were side-tracked.

After Jan. 1, 1925, the personnel of the water power commission will be completely Republican and will be able to function under the provisions of the Robinson law.

While the Republican party has the majority in both branches of the legislature, it has not the two-thirds' majority necessary to pass legislation over the veto of the governor, and it is therefore unlikely that any of the water power legislation providing for state development along the lines suggested in 1924 will prevail, it being anticipated the new administration will content itself with allowing the new water power commission to function under existing statute.

Seattle Files Permit Application for Skagit Development

The city of Seattle has filed with the Federal Power Commission an application for preliminary permit covering its proposed 300,000-hp. municipal development on the Skagit River. The permit states that the proposed dam is to be 400 ft. high and 1,000 ft. long at the crest and 50 ft. at the base. The site selected for the structure is one mile below Ruby Creek. This will create a reservoir of 1,000,000 acre-ft. capacity. It is proposed further to divert Thunder Creek into the reservoir. The pressure tunnel will be three and one-fourth miles long.

Engineering Professor Becomes State Legislator

Prof. Charles A. Holden, director of the Thayer School of Civil Engineering, Dartmouth College, has been elected a representative from the town of Hanover, N. H., to the next session of the New Hampshire Legislature. Prof. Holden was chairman of the Commissioners of the Village Precinct of Hanover from 1913 to 1916 and since August, 1923, he has been a member of the Board of Selectmen for Hanover.

Dean E. M. Cooley, running on the Democratic ticket for U. S. Senator from Michigan, was defeated by his Republican rival, Senator Couzens, the present incumbent.

More Water Storage for Denver Under Investigation

Investigations of foundations at dam sites on the South Platte River have been initiated by the Denver Municipal Water Commission. This move is part of a comprehensive power and storage project providing for storage of double the amount of water impounded back of the existing Cheeseman dam and contemplates the diversion of water from the Western slope at a cost of about $5,000,000. It is understood that a bond issue for this amount will be requested at the next municipal election.

U. S. to Hear of San Joaquin Valley Controversy

The injunction suit brought against the Southern California Edison Co. by land owners in the San Joaquin Valley was discussed at the meeting of the Federal Power Commission Oct. 17. It was decided to call the matter to the attention of the Department of Justice, since the action would have a bearing on the development of the maximum water resources of streams. The land owners who seek the injunction contend that the plans of the Edison company for the construction of reservoirs on the Eastern tributaries of the San Joaquin River will damage their lands because they will prevent floods, which, they claim by inundating these lands periodically benefits them for grazing purposes. The case is unusual, in that judicial intervention is sought to prevent the regularization of stream flow. Should the Attorney General establish that the United States has equities in this case, it would have the effect of transferring the litigation to the United States court.

Jack's Run Bridge

In a note concerning the arch centering of the Jack's Run Bridge at Pittsburgh, Pa., which appeared on p. 686 of the issue of Oct. 23, 1924, the statement was made that Charles F. Bornefeld was resident engineer. Mr. Bornefeld is resident engineer for the contractor. The resident engineer for Norman S. Sprague, the consulting engineer for the county, is Reginald F. Phillips.

Random Lines

Bad News for the Composer of "It Aint Gonna Rain No Mo'"

Bakersfield, Cal., Nov. 7.—"Rainmaker" Hatfield last night closed a contract with the Kern County Cattlemen's Association and the Sheepmen's Association, whereby he promises to produce one and one-half inches of rain in Kern County between Nov. 20 and Dec. 20.

If rain is produced, Hatfield is to receive $4,000, the money being guaranteed by the cattlemen and sheepmen. —*The World*, New York.

* * *

The Engineer is Recognized

"The first train over the new Millvale-Etna high line of the Baltimore and Ohio R.R. carried Daniel Willard, president of the road, west-bound over the new development yesterday morning. Mr. Willard viewed the work from the rear platform of his private car. He waved genially to members of the district engineering force as the train sped by."—*Pittsburgh dispatch.*

There's nothing like these little touches in raising the engineering morale of a railroad.

* * *

Stealing Flo Ziegfeld's Stuff

"An important purpose of the Power Show is to glorify power . . ."—*From a press notice from the Publicity Department, National Exposition of Power and Mechanical Engineering, New York.*

* * *

Higher Education

The University of Pittsburgh is going to put up a 52-story building which will be campus, class rooms and athletic field for that growing institution. This is a triumph of scientific planning, but the impediments of verticality will prevent them from quite so scientific an arrangement of facilities as that other Eastern technical school which some years ago laid out its new building in horizontal extension according to the best rules of Frederick W. Taylor and his followers. There, it was credibly reported, the aim was to arrange the succeeding class rooms and laboratories and work shops so that the student could enter the east door in September and proceeding according to schedule could emerge from the west door in June without having come into the open air.

* * *

An American Defect

For the benefit of those Americans who continue to be uni-lingual and who quake at attempting to learn a foreign language, the following from an Esthonian engineer is offered:

"My English may be difficult to understand, but I beg to advise that I never studied it, but picked it up during a trip in China."

If so excellent a command of idiomatic English is obtainable in oriental wildernesses, there must be something wrong with our method of teaching foreign languages.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, San Francisco, Calif., Nov. 17-20, 1924.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York City; Annual Meeting, New York City, Dec. 3, 1924.

ADVISORY BOARD ON HIGHWAY RESEARCH, Washington, D. C.; Annual Meeting, Washington, Dec. 4, 5.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 5-9, 1925.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 12-14, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 21-23.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

The Engineers' Society of Western Pennsylvania, Civil Section, at its bimonthly meeting Nov. 5 had an illustrated lecture, "Some Notes on Foundations," by Charles R. Gow, consulting engineer, Boston, Mass.

The Society of Engineers of Eastern New York at its meeting Nov. 6 at Albany had an address by E. J. Mehren, vice-president of McGraw-Hill Co. and formerly editor of *Engineering News-Record*, on "The European Economic Outlook," giving interesting information gained in his trip through Europe last summer. The talk was preceded by a dinner of the board of governors of the society.

The American Society of Mechanical Engineers will hold its forty-fifth annual meeting in New York, Dec. 1-4. One of the principal features of the session will be a lecture on the petroleum situation in the United States by Julian D. Sears, administrative geologist of the U. S. Geological Survey. That lecture will be on Tuesday afternoon, Dec. 2. Particular stress will be laid by Mr. Sears upon problems of stabilization and future production, particularly as they affect or may be affected by engineers.

Personal Notes

EDWARD A. KOLBE, chief engineer of the Terminal Railroad Association of St. Louis, Mo., has retired after more than fifty-four years of service with that company and its predecessors. In 1870 he entered the employ of the Illinois and St. Louis Bridge Co., which was building the Eads bridge. When the bridge was completed in 1874 he declined an invitation to join Capt. James B. Eads in his work on the Eads jetties below New Orleans, remaining with the bridge company.

JOHN T. DONAGHEY, acting chief highway engineer of Wisconsin since the resignation of A. R. Hirst, has been appointed state highway engineer. Mr. Donaghey is one of Wisconsin's pioneer road builders. Previous to his work with the state highway commission in 1911, he was Sauk County's highway commissioner.

W. C. BUETOW, bridge engineer for the Wisconsin Highway Commission, has resigned and has accepted a position with the Stein Construction Co. of Milwaukee, Wis., with offices at Minneapolis, Minn.

W. H. JOHNSON, Susanville, Calif., has been advanced from locating engineer for the California State Highway Commission to resident engineer on bridge construction for the bridge department of the commission.

J. R. STUBBINS, who was until recently an assistant engineer of the Wabash Railway Co., is now office engineer of the New Jersey State Highway Department and is located at Jersey City, N. J.

ROGER M. FREEMAN, formerly cost engineer for the L. B. Hawley Co., has a new position as assistant to the resident engineer on the Oakdale hydroelectric development and is located at Monticello, Ind.

J. E. SHEPARDSON, who is valuation engineer for the Nickel Plate railroad, and located at Cleveland, Ohio, was formerly vice-president and general manager of Potter Farms, Inc., a land reclamation company, Belhaven, N. C.

PERRY BROWN has been appointed city manager of Porterville, Calif., a recently created office. Mr. Brown for the past three years was engaged in engineering activities in the Fresno district and prior to that was city engineer and superintendent of streets for Oakland, Calif.

GEORGE W. SCHUSLER, formerly development manager for M. Morgentau Jr. Co., New York City, is now engineer in charge for the Chanin Construction Co., construction engineers, Brooklyn, N. Y.

JOHN MACDONALD, who is professor of building construction at Union College, Schenectady, N. Y., of the Louis and Mary Horowitz Foundation, established by the Thompson-Starrett Co., is a former superintendent of building construction for that company. The course was briefly described in *Engineering News-Record*, Sept. 6, 1923, p. 394.

MAURICE R. SCHARFF has been appointed production and valuation engineer of the Philadelphia Co. and affiliated corporations. Mr. Scharff before going to the company in 1921 had been associated with Morris Knowles, Inc., and prior to that with the Alabama Coal Operators' Association.

G. E. WRIGHT has resigned as assistant city engineer of Gloversville, N. Y., to become engineer for the Trenor Land Co., of New Rochelle, which is developing a large tract into a residential park.

C. E. GARDNER, civil engineer, Pomeroy, Ohio, who has been deputy engineer of Meigs Co., has retired.

ERNEST BOYCE calls attention to an error in a personal note in these columns Oct. 30, p. 727, and states that his work is with the Kansas State Board of Health, not Missouri.

C. H. EIFFERT, formerly maintenance engineer for the Miami Conservancy District, Dayton, Ohio, has been appointed chief engineer and general manager for the District. CHARLES H. PAUL, formerly chief engineer, has been retained as consulting engineer.

Obituary

J. M. MEADE, who was for forty-three years connected with the Santa Fé R.R. and whose final title from 1915 to 1919 was special engineer for the whole system, died Oct. 31 at Topeka, Kan., after a two-years' illness, aged 70 years. He was a native of Virginia and went to school at the Shenandoah Valley Academy. In 1873 he began railroad work as a laborer on the Baltimore & Ohio Ry. and later was with a surveying crew for the Cincinnati Southern in Kentucky. He went to Kansas in 1877 and became assistant superintendent of construction of bridges and buildings. In 1881 he was made resident engineer of the Eastern Division of the Santa Fé. From 1895 to 1898 he served in the same capacity for the Western Division and from 1898 to 1915 was acting engineer for the eastern division.

LOUIS JOSEPH RENÉ STECKEL, a prominent engineer and mathematician, died at Ottawa, Can., on Oct. 31 at the age of eighty years. He was well known in connection with the establishment of a system of geodetic leveling operations along the Richelieu and St. Lawrence Rivers. He was a life member of the Engineering Institute of Canada.

JOHN STERLING DEANS, JR., engineer, general superintendent for and a member of the firm of J. N. Byers & Son, Inc., contractors of Buffalo, N. Y., died recently. Mr. Deans was a graduate of Sheffield Scientific School. After early bridge and railway work for the Pennsylvania R.R. he became its assistant engineer at Buffalo and designed some of its largest classification yards and worked on many yard projects. During the World War he was a captain in the Construction Section, Supply Division, Ordnance Department, and served a short time in France.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Manufacture of Pumps Shows Big Gain for Year 1923

The Department of Commerce announces that, according to data collected at the biennial census of manufactures, 1923, the establishments engaged primarily in the manufacture of pumps reported products valued at $92,928,327, an increase of 32.8 per cent as compared with 1921, the last preceding census year. Of this amount, $35,706,816 was contributed by establishments engaged primarily in the manufacture of hand pumps, $38,958,557 by establishments whose principal products were steam pumps, and $18,262,954 by establishments reporting other kinds of power pumps as their products of chief value. In addition, a considerable number of power pumps and a few hand pumps are manufactured as secondary products by establishments engaged primarily in other industries.

Of the 229 establishments reporting for 1923, 35 were located in California, 29 in Ohio, 26 in New York, 20 in Illinois, 17 in Indiana, 15 in Michigan, 12 each in Massachusetts and Pennsylvania, 9 in Wisconsin, 7 each in Iowa and New Jersey, and 6 in Missouri, and the remaining 34 were distributed throughout 19 other states.

The statistics for 1923 and 1921 are summarized in the statement below.

MANUFACTURE OF PUMPS 1923–1921

	1923	1921	Per Cent of Increase
Number of establishments	229	221	3.6
Wage earners (average number) *a*	14,550	12,186	19.4
Maximum month	July 15,018	Jan. 15,293	....
Minimum month	Jan. 13,419	Oct. 10,627	....
Per cent of maximum	89.4	69.5	....
Wages	$19,990,603	$13,969,531	43.1
Cost of materials (including fuel and containers)	34,464,721	26,803,969	28.6
Products, total value	92,928,327	69,962,413	32.8
Hand pumps	35,706,816	22,723,412	57.1
Steam pumps	38,958,557	35,740,069	9.0
Other power pumps	18,262,954	11,498,932	58.8
Value added by manufacture *b*	58,463,606	43,158,444	35.5
Horsepower	38,896	(*c*)	....
Coal consumed (tons of 2,000 lb.)	84,789	(*c*)	....

a Not including salaried employees nor proprietors and firm members.
b Total value of products less cost of materials.
c Not reported.

Business Notes

ILLINOIS PAVING BRICK MANUFACTURERS' ASSOCIATION, in an effort to promote the proper design and construction of brick pavements, has engaged John M. Egan, Jr., of Aurora, Ill., as chief engineer. After attending the Massachusetts Institute of Technology Mr. Egan spent several years in the South on railway work and for the last 17 years he has been engaged in engineering and contracting on drainage, sewerage and paving projects in the vicinity of Chicago.

PAWLING & HARNISCHFEGER CO., Milwaukee, announces the appointment of H. L. Mode as a sales representative in the eastern territory, with headquarters at New York and Philadelphia. Mr. Mode has had ten years of experience in work with overhead electric traveling cranes, as well as seven years in the motor department of the General Electric Co. N. P. Farrar, until recently district manager of the Philadelphia territory, has been appointed assistant sales manager.

AMERICAN MANGANESE STEEL CO., Chicago Heights, Ill., announces the appointment, effective Oct. 1, of T. B. H. Askin as sales manager for the company's Intermountain Division, with headquarters in Denver. In addition to several years' selling experience in the manganese steel field, Mr. Askin's training includes five years of active mill operation with one of the larger western mining companies.

BLEIER-GALER EQUIPMENT CORPORATION, New York City, dealers in locomotive cranes and hoisting equipment, has been chartered at Albany with $5,000 capital. Oscar Bleier, 144 Bergen Ave.; Louis Bleier, 37 Amherst Ave., Jamaica, N. Y., and E. P. Galer, 248 St. Nicholas Place, New York City, are directors and subscribers. Louis Bleier, 233 Broadway, New York City, is attorney for the corporation.

MONIGHAN MACHINE CO., Chicago, has just moved its general offices and machine shop into the recently completed addition to its factory at August St. and Kilpatrick Ave. on the Belt Railway, Chicago. The original quarters at 2016-2036 Carroll Ave. were outgrown a number of years ago and ground was accordingly purchased at the new site on which a large erecting shop was built. This has been operated in conjunction with the old plant, and now all the manufacturing departments as well as the offices are housed in adjacent buildings at the new address. The newly completed plant gives the company increased capacity and improved equipment for producing the Monighan walking dragline excavator.

NOVO ENGINE CO., Lansing, Mich., manufacturer of gasoline engines, pumps and hoists, has appointed the Central Supply Co., 201 E. Markham St., Little Rock, as distributors for the State of Arkansas.

FAIRCHILD AERIAL CAMERA CORPORATION has developed its aerial survey department to such an extent that a subsidiary corporation, Fairchild Aerial Surveys, Inc., has been formed to handle that branch of the business. Another subsidiary, the Fairchild Flying Corporation, has been formed to own and operate the airplanes formerly owned by the Fairchild Aerial Camera Corporation, and to direct operations involving contracts for flying of every description.

BECKWITH MACHINERY CO., Widener Bldg., Philadelphia, has taken over the agency for McKiernan-Terry products —pile hammers, drills, compressors and lifting jacks—in the eastern half of Pennsylvania, southern part of Jersey, and the State of Delaware. E. G. Stoner is in charge of the Philadelphia office.

UNION WATER METER CO., Worcester, Mass., has opened a new office at 50 Church St., New York City. Edward W. Jacobs, for the past ten years representative of this company in the New York territory, will be in charge. The company, organized in 1868, manufactures water meters of several types, compounding valves, stops, presses for lining service pipe with cement, water pressure regulators and signal whistles.

WHITE CO., Cleveland, will soon complete in that city, directly across the street from its present plant, a new engineering and research building where all the engineering activities contributing to the design and production of White motor trucks will be centralized under one roof. The building will consist of a ground and basement floor 160 x 150 ft. with a second story at the front, and will add 1,500,000 sq.ft. or about 15 per cent to the factory and office area. The company is also expanding southward to take in the plant and office buildings until now occupied by the White Sewing Machine Co.

Equipment and Materials

Wallboard Has Tile Design

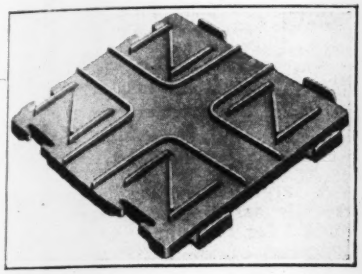
Sheetrock tile board, a new development of fireproof wallboard announced by the United States Gypsum Co., Chicago, consists of slabs of gypsum wallboard, ⅜ in. thick, 4 ft. wide and 6, 7, 8, 9 or 10 ft. long, impressed to represent ceramic tile of the standard size, 2¼x5 in., and is to be finished with enamel. It is designed for wainscoting or entire walls in kitchens, bathrooms, lavatories and laundries in dwelling houses or for other places such as dairies, doctors' and dentists' offices, restaurants and barber-shops where tile is required.

The tile board is nailed horizontally to the studding or over the old wall. The various lengths make it possible in most cases to fit the space with one board so that the joints are made in the corners; in other cases, the joints as well as the nailheads may be effaced with Sheetrock finisher. The tile board surface then is primed with a mixture of equal parts of a good varnish size and flat paint of a color similar to that desired in the completed job. When this is dried, it is

smoothed down with sandpaper. Then two coats of flat paint of the desired color are applied and, when they have dried, the surface is enameled.

Interlocking Steel Plates Form Traction Mat for Trucks

As a substitute for the plank footings which contractors generally use in building excavations for supporting motor trucks during loading the Nugent Steel Castings Co., 3100 South Wood St., Chicago, is offering a "traction



mat," in the form of lightweight interlocking plates of electric furnace steel, 18 in. square and ¾ in. thick; each unit weighs about 30 lb. and is cast with cleats on top and bottom sides to anchor the plate in the ground and to provide a non-slip surface for truck wheels. The interlocking of the plates is accomplished by means of tongues and pockets on the sides of each unit.

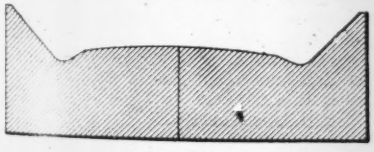
With these plates, the manufacturer claims, a long-wearing, immovable mat of any size may be laid in a few minutes without the necessity of spiking. At the end of each job, of course, the plates are taken up and used over again, outlasting many sets of planking. Plates bent in service may be straightened by laying on a hard street and running a truck over them a few times or else sledged back into shape.

The purpose of the cleats on the upper surface is twofold. They serve as a traction aid for trucks and as a guide for wheelbarrows when the plates are used as runways. With these guides the barrow can not run off the mat, but can be turned out of its path every 18 in.

The steel plate traction mat, it is claimed, will find its principal uses in foundation and tunnel work, around lumbering operations, steel mills, foundries and other places where a replaceable footing is needed for trucks or wheelbarrows. The mat can be interlocked and permanently embedded in the surface of concrete ramps as a traction aid.

Templets for Draftsmen's Use

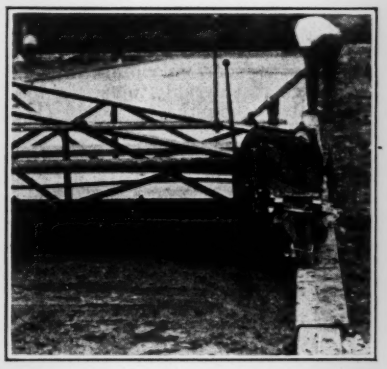
In the preparation of drawings, particularly on highway and railroad work, it is necessary to represent frequently standard cross-sections of roadway. The same applies to a large



extent in drawings of aqueducts, pipe lines and sewers. As a means of simplifying the drafting work for such projects, Turner Devices, Inc., 5 South Newstead Ave., St. Louis, Mo., manufactures to order, from transparent celluloid, templets for standard cross-sections of various kinds. The company has supplied a number of state highway departments with templets of the kind illustrated, showing road sections. The company is prepared to furnish finished templets of any shape or size or amber blanks of any thickness cut to desired sizes. In the latter case, the blanks are machined on one side and both ends so that they can be used against a T-square or straight edge.

Concrete Road Finishing Machine Adapted to Street Paving Work

An adaptation to city paving flanked by stone and concrete curbs has been made of the finishing machine manufactured by the Lakewood Engineering Co., Cleveland, primarily for use on rural concrete roads. In the case of a street construction program at Bedford, Ohio, the finishing machine for spreading and tamping the concrete had to travel on the tops of the curbs instead of along the steel side forms ordinarily used as rails in rural concrete highway construction. To use the finisher under the city conditions the strike-off and tamper of the machine, as shown in the accompanying photograph, were fitted

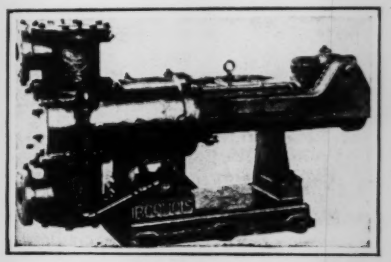


with extensions so that they would operate at the required distance below the tops of the curbs. To protect the curbs, steel plates, bent to a right angle, were laid along the tops, four of these plates, each about 10 ft. long, being used on each side of the pavement. They were taken up and relaid as the machine advanced.

It was not possible to use the regular finishing belt of the machine because the curbs did not provide clearance. The final floating of the surface, therefore, was done with a wooden float extending the full width of the pavement and provided with plow handles on each end. After the mechanical finisher had spread and tamped the slab, which was 8 in. thick, reinforced, one or two trips over it with the wooden float completed the job. One of the features of the work was that the specification provided that the concrete be spread and tamped mechanically. B. T. Wright, village engineer, was in charge of the work.

Steam Jacketed Asphalt Pump

For pumping native lake and oil asphalt and other viscous materials, the Barber Asphalt Co., Philadelphia, has developed the Iroquois steam-jacketed pump, built in sizes of 50, 100 and 200 gal. per minute. The steam jacketing covers all parts through which the asphalt flows, including valves, plunger and plunger packing. With steam in the jacket the pump can be stopped for an indefinite period without the necessity of blowing out or otherwise



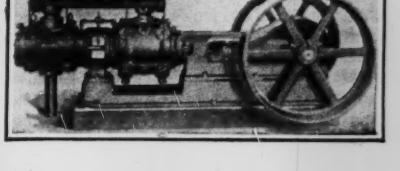
removing asphalt in the pump chamber before putting the pump back into service. Asphalt may be allowed to cool and solidify in the pump chamber, and the pump may be started again by heating the jackets with steam until the asphalt is liquid.

Among the features of the design of the pump are a minimum number of wearing parts in contact with the asphalt; large, straight passages instead of narrow, crooked ones; and absence of springs or other small, easily broken parts in the valve chambers. The pump, the manufacturer claims, will pass foreign matter in the form of pieces of barrel staves, stones, coal or objects of similar size. The ball type of valve used obviates the necessity of springs within the valve chamber. The valve assembly is designed so that by removing the flange directly over the upper wall both valves with seats and cages may be removed through the top of the pump without disturbing any other part of the piping.

Two-Stage Portable Compressor

Two-stage, instead of single-stage, compression is the feature of the new portable belt or motor-driven compressor having a piston displacement of 360 cu.ft. of free air per minute developed by the Chicago Pneumatic Tool Co., Chicago. The machine operates at 275 r.p.m. and delivers air at pressures ranging up to 125 lb. per square inch.

Tandem construction is used in this unit in which the low-pressure cylinder is placed next to the frame and the high and the low-pressure cylinders connected by means of a tandem piece through which the piston-rod stuffing



boxes are easily accessible. The intercooler is mounted above the two cylinders in a position convenient for cleaning, which may be done from either end. Simplate air valves are used throughout. Splash and flood system of lubrication is employed for all bearings, while cylinders may be lubricated by the standard sight-feed lubricator, by a pneumatically operated forced-feed lubricator or by a mechanically driven forced feed lubricator.

Regulation of the volume of air and pressure is automatic. Three steps of capacity regulation are furnished in which two differential unloaders operate automatic unloading inlet valves, causing the compressor to operate at full, half, and no load according to the air demand. Two-stage compression, the manufacturer points out, has not commonly been employed except for machines of more than 500 cu.ft. piston displacement. Among the advantages claimed for two-stage compression are low power consumption per cubic foot of air delivered and favorable physical condition of the air.

Publications from the Construction Industry

Curing Concrete—DOW CHEMICAL Co., Midland, Mich., has issued a 46-p. flexible-bound manual of instruction on the curing of concrete pavements with Dowflake, a perfected form of calcium chloride resembling common salt in appearance, except that it is in the form of flakes rather than small granules.

Blowers—AMERICAN BLOWER Co., Detroit, is distributing a 36-p. illustrated bulletin on the application of its high speed fans to forced draft work where large volumetric capacities and relatively high pressures are necessary in modern central steam power plants. The material presented includes curves, specification sheets, capacity tables and detail dimension sheets.

Water Filters—WILLIAM B. SCAIFE & SONS Co., Oakmont, Pa., has set forth the details of its gravity and pressure filters in a 32-p. illustrated bulletin dealing with the subject of filtration in general and carrying a number of illustrations of typical filter installations for domestic and industrial use. A portion of the text is devoted to coagulation and sedimentation with illustrations and descriptions of solution feeders. Tables of sizes and capacities of filter units conclude the bulletin.

Waterproofing — TRUSCON LABORATORIES, Detroit, has just issued the fourth edition of its 33-p. pamphlet entitled "Science and Practice of Integral Waterproofing," written from the point of view of the layman. The contents of the pamphlet include a discussion of the porosity of the concrete and how moisture can be stopped by a repellant waterproofing compound; specifications applying to the waterproofing of mass concrete; and suggestions on the practical application of plaster or stucco.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Rapid-Fire Survey Of Business Conditions

Ten factors in the current situation that may be taken to indicate **decided improvement in general conditions**, are: (1) Construction to date ahead of same period in record year 1923; (2) record loadings of revenue freight; (3) firmness in stocks and bonds accompanied by heaviest trading on Stock Exchange in past five years; (4) gain in bank debits; (5) increased steel ingot output; (6) improvement in textiles; (7) increased per capita earnings; (8) lowered cost of construction; (9) easy credit conditions and low interest rates; (10) improvement in agricultural outlook.

Three new high records were made by American railroads **in loading of revenue freight**, during the week ended Oct. 25: (1) A total of 1,112,345 cars, all classes, the heaviest week's loading on record; (2) 422,890 cars of miscellaneous freight; (3) 72,474 cars of grain and grain products. Miscellaneous loadings comprise dry goods, automobiles, groceries, etc., in wholesale quantities and are taken as good indicators of general conditions. (Am. Ry. Assoc.)

Business failures for the entire country during the first ten months of the current year, while they were slightly heavier in number and money value than for the corresponding period in 1923, were **considerably under** the totals for the same months in **1922.** (R. G. Dun & Co.)

The amount of **capital required** in various American industries **per wage earner employed,** has been computed by the U. S. Census Bureau as follows:

Food	$6,740	Leather	$4,358
Iron and steel	5,494	Textiles	3,783
Automotive	4,886	Lumber	3,075
All industries			$4,888

Per capita earnings increased in twenty-three out of fifty-two industries during September, 1924. A total of 1,931,000 persons were employed in 6,400 establishments during September, however, as compared with 2,219,000 for the corresponding month last year. This represents a reduction of 13 per cent. (U. S. Dept. of Labor.)

Stock sales on the New York Stock Exchange, Nov. 11, were **the heaviest** recorded **since November, 1919.** There were over 2,258,000 shares of 541 separate issues traded in, with railroads and industrials predominating. Removal of election uncertainties is given as the principal reason for the advance.

Value of contracts let in the U. S. for the first ten months of this year was 4 per cent **greater** than for the same period in 1923. October lettings were 3 per cent **ahead** of September. Judging from last week's report of bids wanted on large commercial buildings and private projects, this month will not be far behind October. (*E. N.-R.* Statistics.)

Bids Wanted on Big Jobs

Among the projects in Construction News, pp. 259 to 271, on which bids are either asked or will soon be called, are the following:

Sewage disposal plant, Trenton, N. J., by City Comn., $1,000,000.

Hotel, Easton, Pa., for Hotel Easton Corp., $1,000,000.

Warehouse, Newark, N. J., by L. Bamberger & Co., $1,000,000.

Is Labor Becoming More Efficient?

A large contracting company was recently asked by *Engineering News-Record* for an opinion or at least an indication of the efficiency of building labor since the war. The reply in part follows:

"I believe on the question of bricklaying we have little or no data which would justify definite conclusions of an increased efficiency in bricklaying from the pre-war period to the present. We have some very definite proofs of such increased efficiency in certain items of carpenter labor such as concrete form work. The whole subject is somewhat complicated on account of the very peculiar conditions during the war period. When labor was not perhaps any less efficient man for man, but taken as a whole on account of dilution and conditions of the work, the final results unless closely analyzed indicate decreased efficiency.

"I might mention one of the most striking examples of a gradual increased efficiency is in erection of our flat slab form work. Prior to 1915 we considered anything better than 4c. per square foot a remarkably good performance. Today with carpenter wages from 25 per cent to 35 per cent higher we are securing a labor cost of better than 3½c. per square foot. In this unit cost is of course included the foreman's time as well as the time of some carpenter's helpers who are receiving from 50c. to 75c. per hour. We have made no radical change in our method of handling the work. We have, however, in the meantime gradually developed our task and bonus wage system which has had, we know, a material effect in the increased efficiency.

"We of course hope we are securing greater skill from the foremen, but we have sufficient evidences of the actual man per hour output to justify a statement that the efficiency on this particular work has substantially increased.

"We can go on through some other items of work and make similar deductions which are particularly interesting on this subject. I think the increased efficiency is more marked in the skilled trades than it is with the common labor. Our data at least would justify this conclusion."

Production Increasing in Most of the Basic Building Materials

Mill and Warehouse Stocks Limited But Sufficient For Current Demand—Smallest Cement Reserve Since 1923

Steel—Steadily increasing production and general improvement in tone, characterize the current steel market. Steel rails, fabricated structurals and tin plates are the most active items on the steel list at the present time. The steel ingot output for the country for October, was the heaviest since April. Following are the monthly production totals, all companies, as calculated by the American Iron and Steel Institute:

	1924 Tons	1923 Tons
Jan.	3,633,639	3,841,095
Feb.	3,809,185	3,471,843
Mar.	4,187,942	4,066,680
Apr.	3,333,535	3,963,736
May	2,628,261	4,216,355
June	2,056,466	3,767,256
July	1,869,416	3,531,458
Aug.	2,541,501	3,695,788
Sept.	2,814,996	3,356,776
Oct.	3,111,452	3,577,091
Ten months	29,986,393	37,488,078

Lumber—Production continues to decrease while shipments and new business are gaining, according to reports of the National Lumber Manufacturers Association for the week ended Nov. 1. Demand is better than a year ago and is increasing from week to week. The following table compares the national lumber movement for the three weeks indicated:

	Week Ended Nov. 1 Ft. b.m.	Corresponding Week in 1923 Ft. b.m.	Preceding Week in 1924 Ft. b.m.
Mills	367	388	348
Production	220,056,042	245,262,606	220,621,112
Shipments	230,773,215	238,261,968	214,527,945
New business	225,152,603	202,98-,209	215,575,526

The following figures compare the lumber movement for the first forty-four weeks of 1924 with the corresponding period last year:

	Production Ft. b.m.	Shipments Ft. b.m.	Orders Ft. b.m.
1924	10,380,785,869	10,293,209,628	9,965,012,523
1923	10,829,801,405	10,781,897,636	10,225,184,904
1924 decrease	449,015,536	488,688,008	260,172,381

Cement—Total output for the entire country for the first nine month of the current year amounted to 110,463,000 bbl., against 101,427,000, for the corresponding period last year, according to the Geological Survey. Shipments for the same periods were 112,792,000 bbl. this year, compared with 104,943,000, last. The increase of 9 per cent in production and 8 per cent in shipments resulted in a net reserve for the entire country of 8,358,000 bbl., Oct. 1, 1924, as against 5,533,000 bbl. on the same date last year. This is the smallest reserve stock for the nation reported since Dec. 31, 1923.

Brick—There are more burned common brick on hand at yards throughout the country now, than at anytime since June, when the new 1924 brick entered the market in the northern areas where production ordinarily ceases during the colder months. There is a slight seasonal decline in shipments and orders, however, according to reports of the Common Brick Manufacturers Association of America. The following table shows the situation as of Oct. 1, 1924:

	Burned Brick on Hand M.	Unburned Brick on Hand M.	Brick Moved from Yards During Month M.	Orders on Books M.
1923				
Oct. 1	307,633	143,641	.....	356,429
1924				
June 1	223,458	70,802	163,298	394,156
July 1	258,474	72,725	158,753	366,098
Aug. 1	231,182	86,722	149,622	314,588
Sept. 1	261,800	68,138	120,777	256,017
Oct. 1	272,172	61,150	111,846	226,529

With the exception of cement, perhaps, the volume of current production is considerably under the same period last year. Buying is increasingly active but for immediate needs only. No tendency to purchase for replenishment of stocks has yet developed. While mill and warehouse reserves are not large, the demonstrated ability of the railroads to handle unprecedented quantities of freight without delay, should serve to diminish any fears of serious materials shortages in the near future.

Big South American Port Project Now Out for Bids

The Colombian Government has made a detailed study of the possibilities of building stone jetties at the mouth of the Magdalena River for the purpose of deepening the channel through the bar which is located there. This will give ocean going steamers access to the city of Barranquilla which is situated on the west bank of the river, six miles above the mouth. It is a thriving town of eighty thousand inhabitants and a busy manufacturing and commercial distributing center.

The proposed expenditure on this project is estimated at $3,500,000 including protection and regulation works on the river between Barranquilla and the mouth, also some dredging on the bar. Besides this work, ample wharves and warehouses will be built on the river front in Barranquilla. On Sept. 20, 1924, the Colombian Congress made full appropriation for the required funds.

Contractors desiring to make bids should apply to the Minister of Public Works in Bogota at the following address: Señor Ministro de Obras Públicas, Bogota, Col., S. A.

Time may be saved by a cable message stating the desire to make a bid and asking for specifications and instructions; a letter may follow.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 259 to 271, are the following:

Subway, Brooklyn, N. Y., Transportation Bd., Sec. C and D to Oakdale Constr. Co.; Sec. B to Underpinning and Foundation Co., total, $9,531,204.

Office and loft, New York, N. Y., A. Bricken, work will be done under separate contracts, $3,500,000.

Plant, Norfolk, Va., Portland Cement Corp., work will be done under separate contracts, $1,500,000.

Apartment, New York, N. Y., One Hundred Twenty Eight Central Park South Corp., work will be done under separate contracts, $1,250,000.

Temple, Cleveland, O., B'Nai Jeshuran Congregation to Lundoff-Bicknall Co., $1,000,000.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Common brick, Denver, 10,000,000); time required for delivery of carload lots to city job, example: (Hollow tile, Atlanta, deliveries take 4 to 5 days); and stocks on hand in general terms, example: (Sewer pipe, Philadelphia, over 100 cars; normal)

	San Francisco	Denver	Detroit	New Orleans	Atlanta	Philadelphia	New York
Sewer pipe	Plenty all sizes	Shipments keeping up with orders	Moderate supply in local yards	Stocks plentiful	Del. take 4 to 5 days	Over 100 cars; normal	Shortages at mills
Cement	Fairly well supplied	Stocks in good shape	Local and nearby mills able to meet any demand	Sufficient	About 70 cars on sidings	Well supplied	No reserve stocks
Lime	Sufficient for current demand	Enough	Del. good from Mich. and Ohio kilns	Adequate	About 75 cars	Enough for current demand only	Dealers' stocks usually small
Common brick	Large reserves at yards	10,000,000 on hand	Ample supply in local yards	Normal	Plenty	Supply normal	More burned brick than month ago; heavy rail shipments
Hollow tile	Plentiful	Del. behind orders	Del. take serveral days on large orders	Plentiful	Del. take 4 to 5 days	Small stocks carried	Dealers' stocks usually small; prompt del. by rail and water
Lumber	Unusually large reserves in yards 71,045 M.ft. in L. A.	Stocks in good shape	Yard stocks about average	Enough; demand fair	Plenty	Sufficient	Stocks smaller; shipments and demand increasing
Asphalt	Extensive native reserves	Small reserves	.....	Sufficient; demand fair	About 60 cars	No reserves	Ref. nearby
Structural steel	Warehouses heavily stocked particularly in reinforcing bars	Warehouses well supplied	.....	Plentiful	About 4 cars	Moderate supplies in warehouses	Warehouse stocks below normal

Exports Exceeded Imports for First Nine Months of 1924

That exports from the United States for the first nine months of this year were 14 per cent ahead of imports for the same period, is shown in a recent analysis of the situation by the Bureau of Foreign and Domestic Commerce. It also develops that exports were considerably heavier during that period than for the corresponding month last year. Imports, from Jan. 1 to Oct. 1, 1924, were slightly under those for the same months in 1923. Crude materials for use in manufacturing form the principal group in the import list, while manufactures ready for consumption represent the heaviest percentage of total exports. In the latter class a gain of over 7 per cent has been realized.

IMPORTS INTO AND EXPORTS FROM THE UNITED STATES, JAN. 1 TO OCT. 1, 1923-4.

	Imports				Exports			
	1923		1924		1923		1924	
	Value	Per Cent	Value	Per Cent	Value	Per Cent	Value	Per Cent
Crude materials for use in manufacturing	$1,095,720,000	38	$897,002,000	33	$709,380,000	25	$799,094,000	26
Foodstuffs, crude and food animals	253,178,000	9	304,305,000	11	206,396,000	7	191,248,000	6
Foodstuffs, partly or wholly manufactured	418,291,000	14	426,627,000	16	423,680,000	15	407,090,000	13
Manufactures for further use in manufacturing	557,294,000	19	477,534,000	18	417,912,000	14	452,546,000	15
Manufactures ready for consumption	567,695,000	20	549,754,000	21	1,120,140,000	39	1,200,230,000	40
Miscellaneous	11,959,000	...	15,711,000	1	4,322,000	..	4,225,000	
Total	$2,904,136,000	100	$2,670,933,000	100	$2,881,830,000*	100	$3,054,433,000*	100

* Domestic exports.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 6, the next, on December 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$4.00	$3.00	$3.35	$3.50
Structural rivets, 100 lb.	3.75	4.35	4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	3.00	3.25	3.87½	3.35	3.25	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	53%	55.45%	36%	43.1@54.4%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	56.60@57.60	+56.00	—56.75	56.20@57.20	55.50	68.00	56.00	65.00	65.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	—2.65	1.80
Gravel, ¾ in., cu.yd.	+2.00	1.90	2.38	2.75	1.65	1.90	2.61	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.75	1.75	2.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	55.00	—34.00	57.20	55.00	+38.75	+36.75	—29.00	26.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	23.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.50@3.00	1.45	1.85	1.50	1.35	2.70	1.60	2.80	10.50
Common brick, delivered, 1,000	18.00	—10.50	+12.10	12.00	14.00	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.1004	.0941	.089	.07	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.1004	.0941	.089	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	1.08	+1.15	1.20	1.05	1.13	1.23	1.12	1.12	1.13
Common Labor:									
Common labor, union, hour	.75	.30	.....	.82½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.40@.75	.75	.50@.55	.35@.50	.50	.62½	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.60 for Kelly Island and Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.96). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $37.83.

Conditions Affecting the Market

While the general trend of wholesale prices (all commodities) is upward, building materials have been gradually working downward during the past six months. Wherever price advances have occurred in this week's market, the declines have been sufficiently pronounced to give a slight excess in favor of the latter.

A downward revision in wrought-pipe prices is under way in the San Francisco district. Discontinuance of the Pittsburgh Plus system has had a similar effect upon pipe quotations in Minneapolis.

Seattle is the only city out of nine, reporting weekly to *Engineering News-Record*, to show a reduction in cement. The decline amounts to 25c. per bbl. Fir lumber, however, is tending upward in that district

In New York, the market for gravel and other aggregates has developed firmness since the last week in October. Linseed oil rose 1c. per gal in Atlanta during the week; the other eight cities reported no changes in this commodity.

Three Western cities, namely: Seattle, Tacoma and St. Louis, report October building permits in greater volume than for the same month last year. Seattle in fact, has established a new record for that particular month. Los Angeles, however, reports a decrease of nearly 48 per cent comparing October of this year with last.